PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE HONORABLE BOARD OF PATENT
APPEALS AND INTERFERENCES

Application No.:	10/827,465
Filing Date:	April 19, 2004
Applicant:	Terry L. Turner et al.
Group Art Unit:	3721
Examiner:	Nathaniel C. Chukwurah
Title:	POWER TOOL WITH BATTERY PACK EJECTOR
Attorney Docket:	0275S-000510/COB

Mail Stop Appeal Brief – Patents
Director of the U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, Virginia 22313-1450

SUBMISSION OF APPEAL BRIEF

Dear Sir:

Appellants submit herewith their Brief on Appeal as required by 37 C.F.R. 41.37

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BRIEF ON BEHALF OF APPELLANTS

In support of the Notice of Appeal filed May 30, 2007, appealing the Examiner's Final Rejection mailed January 30, 2007 (which is attached in the Evidence Appendix at Tab A) of each of pending claims 23-38 of the present application, which appear in the attached claim appendix, Appellants hereby provide the following remarks.

1. REAL PARTY IN INTEREST

Black & Decker Inc. is the real party in interest, being the assignee of the present application.

2. RELATED APPEALS AND INTERFERENCES

To the best of Applicants' knowledge, no other appeals or interferences are pending which will directly affect or be directly affected by or have a bearing on the Board's decision in the present pending appeal.

3. STATUS OF THE CLAIMS

Claims 1-22 are cancelled. Claims 23-38 stand finally rejected. Claims 23-38 are being appealed and are attached in the Claims Appendix.

4. STATUS OF THE AMENDMENTS

No claims were amended in the Amendment filed April 25, 2007. However, the Examiner indicated in the Advisory Action dated May 16, 2007 (attached as Exhibit B in the Evidence Appendix) that the Amendment did not place the application in condition for allowance. The claims are attached in the Claim Appendix.

5. SUMMARY OF CLAIMED SUBJECT MATTER

There are two independent claims, Claim 23 and Claim 29. Independent Claim 23 relates to a power tool housing 12 having a mechanism for ejecting a battery pack 30. Independent Claim 29 relates to a power tool 10 including the housing with the ejecting mechanism.

The housing 12 includes a motor portion 14 and a handle portion 16 which extends away from the motor portion 14. A base portion 18 is at the distal end of the handle portion 16 away from the motor portion 14 to form a terminus of the housing 12. ¶15, page 5, lines 1-14 (Fig. 1). A frame 32 is received in the base portion 18. The frame 32 includes a cavity 40 to receive a battery pack 30 at the distal end of the handle portion 16. ¶16, page 6, lines 1-3 (Fig. 1). A receiving member 34, 36 receives a member 80, 82 on the battery pack 30 to couple the battery pack 30 with the power tool housing 12. ¶16, page 6, lines 3-8. A biasing member 62, 64 is in the cavity 40. The biasing member 62, 64 ejects the battery pack 30 from the receiving member 34, 36. ¶17, page 6, lines 4-5; ¶20, page 8, lines 5-10 (Fig. 4). The battery pack 30 is received in the receiving member 34, 36 so that the battery pack 30 is in contact with the biasing member 62, 64 so that when the battery pack 30 is secured on the frame 32, the biasing member 62, 64 is in a compressed condition. When the battery pack 30 is released from the frame 32, the biasing member 62, 64 ejects the battery pack 30 from the frame 32. ¶19, pages 7 and 8, lines 1-10; ¶20, page 8, lines 1-10).

Independent Claim 29 relates to a power tool 10 which includes a battery pack 30 and housing 12. The housing 12 includes a motor portion 14, a handle portion 16

extending away from the motor portion 14. A base 18 is at the distal end of the handle portion 16 away from the motor portion 14 forming a terminus of the housing 12. ¶15, page 5, lines 1-14 (Fig. 1). A motor 20 is positioned in the housing 12. An output 22 as well as an activation member 26 activates the motor 20. The battery pack 30 is received on the base 18 of the housing 12. ¶15, pages 5-6, lines 5-8 (Fig. 1). The mechanism is on the base portion 18 of the housing 12 to receive the battery pack 30 at the distal end of the handle portion 16. The mechanism includes a frame 32 which includes a cavity 40 to receive the battery pack 30. ¶16, page 6, lines 1-8 (Fig. 1). A receiving member 34, 36 meshes with the member 80, 82 on the battery pack 30 to receive the battery pack 30 in the cavity 40. ¶16, page 6, lines 3-8. A biasing member 62, 64 is in the cavity 40. The biasing member 62, 64 ejects the battery pack 30 from the ejecting mechanism. ¶17, page 6, lines 4-5; ¶20, page 8, lines 5-10 (Fig. 4). When the battery pack 30 is locked into the frame 32, the biasing member 62, 64 is in a compressed condition and when the battery pack 30 is in an unlocked condition, the biasing member 62, 64 eject the battery pack 30 from the frame 32. ¶19, pages 7 and 8, lines 1-10; ¶20, page 8, lines 1-10.

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

(a) Claims 23-38 are obvious under 35 U.S.C. §103(a) as being unpatentable over Mooty et al. (U.S. Patent No. 6,656,626 which is attached in the Evidence Appendix at Tab C) in view of Maeda et al. (U.S. Patent No. 5,189,570 which is attached in the Evidence Appendix at Tab D).

7. ARGUMENT

(a) Rejection of Claims 23-38 as being unpatentable over Mooty et al. in view of Maeda et al.

The Mooty et al. reference illustrates a power tool 100 with a battery release mechanism located at a free terminal end of the tool. The battery release mechanism includes a generally elongated closure member 130 that is situated within the battery receiving portion 112 substantially perpendicular to the first and second guide channels 116 and 119 as best seen in Figs. 6, 7a and 7b. Mooty et al. illustrates a biasing member 125 buried in the handle portion of the drill that acts in a direction perpendicular to the guide channels, as best illustrated in Figs. 7a and 7b. The biasing member 125 activates the closure member 130 and does not contact the battery pack as claimed by Applicants.

The Mooty et al. reference teaches away from Applicants' claims. Mooty et al. operates exactly opposite to the operation of Applicants' claims. In Mooty et al., the spring 125 is extended when the battery is locked in the housing. The spring 125 is compressed when the battery is allowed to be pulled off of the channels 116 and 119. See, Figs. 7a and 7b. Further, the battery is not ejected from the housing by the spring as claimed by Applicants. The battery must be physically removed from the channels after a blocking portion 136 of the locking closure 130 has been moved out of the channel 119 to a release position.

The Examiner then combines Mooty et al. with Maeda et al. Maeda et al. illustrates a magnetic head advancing/retracting device for rotating magnetic recording media. The device includes a mechanism inside of the housing to automatically eject a battery pack

only when the device senses a lower power level in the battery.

The Examiner, on page 3 of the Final Office Action attached in the Evidence Appendix at Tab A, concludes:

> In view of the teaching of the references of Maeda et al., it would have been obvious to one skilled in the art at the time of the invention to modify the battery pack receiving member of Mooty et al. such that the secured battery pack compresses the biasing member in order to more effectively detach of the battery pack from the frame.

The Supreme Court in KSR International Co. v. Teleflex Inc., 127 S. Ct. 1727, 82 USPQ2d 385 (2007) stated:

> Although common sense directs one to look with care at a patent application that claims as innovation the combination of two known devices according to their established functions, it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in a way that the claimed new invention does. This is so because inventions and more, if not all, instances rely upon building blocks long since undiscovered, and claimed discoveries almost of necessity will be a combination of what, in some sense, is already known.

The Court further stated that:

> Often it will be necessary for a Court to look to interrelated teachings of multiple patents; the effects of demands known to the design community are present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, the analysis should be implicit. See, In re Kahn, 441 F.3d. 977 at 988 (CA Fed. 2006) rejections on obvious grounds cannot be sustained by mere conclusory statements; instead thus must be some articulated reasoning with some rationale underpinning to support the legal conclusion of obviousness.

Here, the Examiner has failed to provide any explicit reasoning why the above combination is obvious. There is no rationale underpinning as to why, as required by

KSR International, only the Examiner's conclusion. The Examiner's naked assertion that one could be substituted for the other is insufficient.

Specifically, the Examiner has failed to provide a "rational underpinning" as to why or how Mooty et al. would be capable of functioning when the spring 125 compression state and extension state are reversed. Further, the Examiner has failed to provide a "rational underpinning" as to how Mooty et al. is to be modified so that the spring 125, that biases the closure member 130, buried in the housing below the rails 116 and 119 is to contact the battery pack as claimed by Applicants.

Further Maeda et al. teaches away from enabling the operator to remove the battery, when desired, from the power tool. Accordingly, one skilled in the power tool art, desiring to have an operator eject the battery from the free terminal end of the power tool, would not look to a reference, Maeda et al., that teaches the ejector inside the housing and prohibits the operator from removing the battery.

Accordingly, the Examiner's failure to provide explicit reasoning and the fact that the references teach away from Applicants' claims indicate that the Examiner has improperly applied §103.

In independent Claim 29, the Examiner has applied the same reasoning as in Claim 23. Accordingly, the above remarks equally apply to independent Claim 29.

8. CONCLUSION

Applicants respectfully submit that the Examiner has failed to show a prima facie case of obviousness. The references do not render Applicants' claims obvious to those skilled in the art.

Accordingly, reversal of the final rejection of Claims 23-38 and allowance of the claims is respectfully submitted.

Respectfully submitted,
HARNESS, DICKEY & PIERCE, P.L.C.

Dated: July 30, 2007

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Attorney Docket No. 0275S-000510/COB
Enclosures

CLAIMS APPENDIX

CLAIMS ON APPEAL FOR U.S. SERIAL NO. 10/827,465

23. A power tool housing having a mechanism for ejecting a battery pack, comprising:

said housing including motor portion and a handle portion extending away from said motor portion, and a base portion at a distal end of said handle portion away from said motor portion to form a terminus of said power tool housing;

a frame in said base portion;

a cavity in said frame for receiving a battery pack at the distal end of the handle portion;

a member for receiving a member on the battery pack to couple the battery pack with the power tool;

a biasing member in said cavity, said biasing member for ejecting said battery pack from said receiving member; and

said battery pack received in said receiving member so that said battery pack is in contact with said biasing member such that when the battery pack is secured on said frame, said biasing member is in a compressed condition and when the battery pack is released from said frame, said biasing member ejects the battery pack from the frame.

24. The power tool housing according to Claim 23, wherein said cavity defined by a pair of opposing side walls and an end wall adjoining said opposing side walls.

25. The power tool housing according to Claim 24, wherein said receiving member including a pair of extending rails on each side wall, said rails opposing one another.

26. The power tool housing according to Claim 25, wherein channels are formed adjacent said side walls and between said rails and frame for receiving mating rails on the battery pack.

27. The power tool housing according to Claim 23, wherein said biasing member including at least one helical spring.

28. The power tool housing according to Claim 23, wherein said biasing member extending from an end wall of said frame.

29. A power tool, comprising:

a battery pack;

a housing, said housing including a motor portion, a handle portion adjacent said motor portion and extending away from said motor portion, and a base portion at a distal end of said handle portion away from said motor portion forming a terminus of said housing;

a motor in said housing;

an output coupled with said motor;

an activation member for activating said motor;

a mechanism on said base portion of said housing for receiving a battery pack at the distal end of the handle portion including:

a frame;

a cavity in said frame for receiving a battery pack;

a member for receiving a member on the battery pack to couple the battery pack with the housing;

a biasing member in said cavity, said biasing member for ejecting said battery pack from said housing; and

said battery pack received in said receiving member so that the battery pack is in contact with said biasing member such that when the battery pack is secured on said housing, said biasing member is in a compressed condition and when the battery pack is released from the housing, said biasing member ejects the battery pack from the frame.

30. The power tool according to Claim 29, wherein said cavity defined by a pair of opposing side walls and an end wall adjoining said opposing side walls.

31. The power tool according to Claim 30, wherein said receiving member including a pair of extending rails on each side wall, said rails opposing one another.

32. The power tool according to Claim 31, wherein channels are formed adjacent said side walls and between said rails and frame for receiving mating rails on the battery pack.

33. The power tool according to Claim 29, wherein said biasing member including at least one helical spring.

34. The power tool according to Claim 30, wherein said biasing member extending from said end wall.

35. The power tool according to Claim 29, wherein said battery pack including a pair of rails mating in said channels.

36. The power tool according to Claim 35, wherein said battery pack rails including an upper portion, lower portion and a channel between said upper and lower portions.

37. The power tool according to Claim 29, wherein said at least one helical spring partially ejects said battery pack.

38. The power tool according to Claim 35, wherein said battery rails slide in said channels and said frame rails suspend said battery pack from said tool housing.

EVIDENCE APPENDIX

Statement Setting Forth Where Evidence Was Entered by Examiner

U.S. Patent No. 6,656,626 to Mooty et al. was entered by Examiner in the Office Action dated March 22, 2006 in the PTO Form 892.

U.S. Patent No. 5,189,570 to Maeda et al. was entered by Examiner in the Office Action dated August 29, 2006 in the PTO Form 892.

EXHIBIT A

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/827,465	04/19/2004	Terry L. Turner	0275S-510COB	2992

27572 7590 01/30/2007
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EXAMINER	
CHUKWURAH, NATHANIEL C	
ART UNIT	**PAPER NUMBER**
3721	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/30/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/827,465	TURNER ET AL.	
	Examiner	Art Unit	
	Nathaniel C. Chukwurah	3721	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 29 November 2006.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 23-38 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 23-38 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 22 August 2005 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

5. SUMMARY OF CLAIMED SUBJECT MATTER

There are two independent claims, Claim 45 and Claim 50. Independent Claim 45 relates to a mechanism for ejecting a battery pack 30 from the housing 12 of a power tool 10. Independent Claim 50 relates to a power tool 10 within the ejecting mechanism.

The mechanism includes a frame 32 which includes a cavity to receive the battery pack 30. ¶16, page 6, lines 1-8 (Fig. 1). An electrical connector housing 52 is in the cavity 40 to electrically connect with the battery back 30. ¶17, page 6, lines 1-4 (Fig. 2). A receiving member 34, 36 meshes with a member 80, 82 on the battery pack 30 to receive the battery pack 30 in the cavity 40. ¶16, page 6, lines 3-8. A biasing member 62, 64 is in the cavity 40. The biasing member 62, 64 injects the battery pack 30 from the ejecting mechanism. ¶17, page 6, lines 4-5; ¶20, page 8, lines 5-10 (Fig. 4). A bore 58, 60 in the electrical connector housing 52 receives and maintains the biasing member 62, 64 in the frame. When the battery pack 30 is locked into the frame 32, the biasing member 62, 64 is in a compressed condition and when the battery pack 30 is in an unlocked condition, the biasing member 62, 64 ejects the battery pack 30 from the frame 32. ¶19, pages 7-8, lines 1-10; ¶20, page 8, lines 1-10.

Independent Claim 50 relates to a power tool 10 which includes a housing 12 with a motor 20. The motor 20 is coupled with an output 22 as well as an activation member 26 which activates the motor 20. The battery pack 30 is received on the housing portion 18. ¶15, pages 5-6, lines 1-8 (Fig. 1). The power tool 10 includes an ejection mechanism like that defined in independent Claim 45.

DETAILED ACTION

1. This office action is in response to the remarks filed on 11/29/2006.

2. The Terminal Disclaimer filed on 11/29/2006 has bee approved.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 23-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mooty et al. (US 6,656,626) in view of Maeda et al. (US 5,189,570).

With regard to claim 23, the reference of Mooty et al. discloses a power tool housing (102) having a mechanism for ejecting a battery pack (108), comprising: the housing including motor portion (103) and a handle portion (104) extending away from the electric motor portion and a base portion (106) at a distal end of the handle portion away from the motor portion to form a terminus of the power tool housing (102), a frame (115 mounting surface) in the base portion (106); a cavity (114 opening) in the frame for receiving a battery pack (108) at the distal end of the handle portion (104); a member (116, 119) for receiving a member (152,155) on the battery pack (108) to couple the battery pack with the power tool (100);

a biasing member (125, 130) in the cavity (114), the biasing member (125, 130) for ejecting (releasable) the battery pack (108) from the receiving member (116, 119); and the battery pack (108) received in the receiving member (116, 119) so that the battery pack is in contact with the biasing member (125, 130).

The reference of Mooty et al. discloses the claimed subject matter but lacks the specific teaching of the battery pack secured on the frame, and in contact with the biasing member in a compressed condition.

The reference of Maeda et al. teaches the claimed feature as shown in Figures 9 and 10 wherein the battery pack (70) is secured and in contact with the biasing member (81) in compressed condition, further the battery pack is ejected and released from the frame.

In view of the teaching of the references of Maeda et al., it would have been obvious to one skilled in the art at the time of the invention to modify the battery pack receiving member of Mooty et al. such that the secured battery pack compresses the biasing member in order to more effectively detach of the battery pack from the frame.

With regard to claim 24, the power tool housing of Mooty et al., includes the cavity

(114 opening) defined by a pair of opposing side walls and an end wall adjoining the opposing side walls as shown in Figures 7A and 7B.

With regard to claim 25, the receiving member (114 opening) of power tool housing of Mooty et al. includes a pair of extending and opposing rails on each side wall as shown in Figure 6.

With regard to claim 26, the power tool housing of Mooty et al. includes channels formed adjacent the side walls and between the rails and frame as shown in Figure 6, for receiving mating rails (152, 155) on the battery pack (108).

With regard to claim 27, the power tool housing Mooty et al. includes at least one helical spring (125).

With regard to claim 28, the modified power tool housing of Mooty et al. includes the biasing member extending from an end wall of the frame.

With regard to claim 29, the reference of Mooty et al. discloses a power tool (100), comprising: a battery pack (108); a housing (102), the housing (102) including a motor portion (103), a handle portion (104) adjacent the motor portion (103) and extending away from the motor portion and a base portion (106) at a distal end of the handle portion (104) away from the motor portion (103) forming a terminus of the housing (102), a motor (electric motor) in the housing (102), an output (105) coupled with the motor (electric motor); an activation member (107)

for activating the motor (electric motor); a mechanism (securement) on base portion (106) of the housing (102) for receiving a battery pack (108) at the distal end of the handle portion (104) including: a frame (115 mounting surface); a cavity (114 opening) in the frame (115) for receiving a battery pack (108), a member (116, 119) for receiving a member (152,155) on the battery pack (108) to couple the battery pack with the housing (102); a biasing member (125, 130) in the cavity (114 opening), the biasing member (125, 130) for ejecting the battery pack (108) from the housing (102), and the battery pack (108) received in the receiving member (116, 119) so that the battery pack (108) is in contact with the biasing member (125, 130) such that the battery pack(108) is secured on the housing (102).

The reference of Mooty et al. discloses the claimed subject matter but lacks the specific teaching of the battery pack secured on the frame, and in contact with the biasing member in a compressed condition.

The reference of Maeda et al. teaches the claimed feature as shown in Figures 9 and 10 wherein the battery pack (70) is secured and in contact with the biasing member (81) in compressed condition, further the battery pack is ejected and released from the frame.

In view of the teachings of the reference of Maeda et al., would have been obvious to one skilled in the art at the time of the invention to modify the battery pack receiving member of Mooty et al. such that the secured battery pack compresses the biasing member in order to more effectively detach of the battery pack from the frame.

With regard to claim 30, the power tool (100) of Mooty et al., includes the cavity

(114 opening) defined by a pair of opposing side walls and an end wall adjoining the opposing side walls as shown in Figures 7A and 7B.

With regard to claim 31, the receiving member (114 opening) of the power tool of Mooty et al. includes a pair of extending and opposing rails on each side wall as shown in Figure 6.

With regard to claim 32, the power tool of Mooty et al. includes channels formed adjacent the side walls and between the rails and frame as shown I Figure 6, for receiving mating rails (152, 155) on the battery pack (108).

With regard to claim 33, the power tool of Mooty et al. includes at least one helical spring (125).

With regard to claim 34, the modified power tool of Mooty et al. includes the biasing member extending from an end wall of the frame.

With regard to claim 35, the battery pack of the power tool of Mooty et al. includes a pair of rails (152, 155) mating in the channels as shown in Figure 6.

With regard to claim 36, the battery pack (108) rails of the power tool of Mooty et al. includes an upper portion (154 Fig.11), lower portion (158 Fig. 11) and a channel as shown in Figure 11 between the upper and lower portions.

With regard to claim 37, the modified power tool of Mooty et al. includes the at least one helical spring which is capable of partially ejecting the battery pack.

With regard to claim 38, the power tool of Mooty et al. includes as shown in Figures 13A, 13B and 13C, wherein the battery rails slide in the channels and the frame rails suspend the battery pack from the tool housing.

Response to Arguments

5. Applicant's arguments filed 11/29/2006 have been fully considered but they are not persuasive.

Applicant argues that the reference of Mooty relates to power tool, while Maeda et al. relates to magnetic head advancing and retracting device; therefore the reference are not combinable. The present invention relates to battery ejection mechanism which have been taught by the combination of the references as stated in the rejection.

Therefore, the examiner contends that the battery ejection mechanism in the reference of Maeda et al. as discussed in the rejection, when incorporated into the reference of Mooty, teaches the claim limitation.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

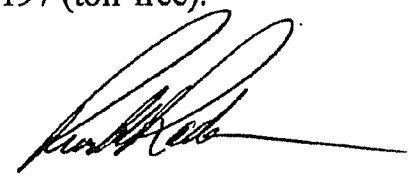
7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nathaniel C. Chukwurah whose telephone number is (571) 272-4457. The examiner can normally be reached on M-F 6:00AM-2:30PM.

8. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Rinaldi Rada can be reached on (571) 272-4467. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

9. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

NC

January 23, 2006.



Rinaldi I. Rada
Supervisory Patent Examiner
Group 3700

EXHIBIT B

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/827,465	04/19/2004	Terry L. Turner	0275S-510COB	2992

27572 7590 05/16/2007
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EXAMINER	
CHUKWURAH, NATHANIEL C	
ART UNIT	**PAPER NUMBER**
3721	

MAIL DATE	DELIVERY MODE
05/16/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

HH

Advisory Action Before the Filing of an Appeal Brief	**Application No.** 10/827,465	**Applicant(s)** TURNER ET AL.	
	Examiner Nathaniel C. Chukwurah	**Art Unit** 3721	

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 25 April 2007 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

1. ☒ The reply was filed after a final rejection, but prior to or on the same day as filing a Notice of Appeal. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114. The reply must be filed within one of the following time periods:
   a) ☐ The period for reply expires _____ months from the mailing date of the final rejection.
   b) ☒ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

   Examiner Note: If box 1 is checked, check either box (a) or (b). ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☐ The proposed amendment(s) filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   (a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below);
   (b) ☐ They raise the issue of new matter (see NOTE below);
   (c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   (d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

   NOTE: _____. (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☐ For purposes of appeal, the proposed amendment(s): a) ☐ will not be entered, or b) ☐ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.
   The status of the claim(s) is (or will be) as follows:
   Claim(s) allowed: _____.
   Claim(s) objected to: _____.
   Claim(s) rejected: _____.
   Claim(s) withdrawn from consideration: _____.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ The affidavit or other evidence filed after a final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

11. ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: See Continuation Sheet.
12. ☐ Note the attached Information Disclosure Statement(s). (PTO/SB/08) Paper No(s). _____
13. ☐ Other: _____.

Rinaldi I. Rada
Supervisory Patent Examiner
Group 3700

Continuation of 11. does NOT place the application in condition for allowance because: Applicant's remarks filed 04/25/2007 have been carefully reviewed and found unpersuasive; because the combination of the references of Mooty et al. and Maeda et al. disclose the battery ejection mechanism as claimed, therefore the rejections in the final office action mailed on 01 /30/2007 have been maintained.

EXHIBIT C

US006656626B1

(12) **United States Patent**
Mooty et al.

(10) **Patent No.: US 6,656,626 B1**
(45) **Date of Patent: Dec. 2, 2003**

(54) **CORDLESS POWER TOOL BATTERY RELEASE MECHANISM**

(75) Inventors: **Tom Mooty**, Jackson, TN (US); **Earl Clowers**, Anderson, SC (US); **Mark Etter**, Jackson, TN (US); **Daily Gist**, Jackson, TN (US); **Michael Lagaly**, Jackson, TN (US)

(73) Assignee: **Porter-Cable Corporation**, Jackson, TN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/577,653**

(22) Filed: **May 24, 2000**

Related U.S. Application Data

(63) Continuation-in-part of application No. 29/105,748, filed on Jun. 1, 1999, now Pat. No. Des. 435,414.

(51) **Int. Cl.**[7] **H01M 2/10**
(52) **U.S. Cl.** **429/99**; 429/100; 30/500
(58) **Field of Search** 429/99, 100; 30/500

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(List continued on next page.)

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(List continued on next page.)

Primary Examiner—John S. Maples
(74) *Attorney, Agent, or Firm*—Suiter West PC LLO

(57) **ABSTRACT**

A battery release mechanism for releasably securing a battery to a power tool is disclosed. The battery release mechanism includes a battery receiving portion integral with a handle portion of the power tool and an attachment portion integral with the battery. The attachment portion is configured to engage the battery receiving portion. The battery release mechanism also includes a closure member that is operable with and transversely disposed within the battery receiving portion. The closure member is configured to secure the battery within the battery receiving portion when the closure member is in a "lock" position. The closure member has a first end and a second end opposite the first end. The first end is disposed through a side wall of the tool housing and defines a push button for selectively moving the closure member from the "lock" position to a "release" position. When the closure member is in the "release" position, the battery can be removed from the power tool. A method of releasably securing a battery to a power tool is also disclosed.

57 Claims, 9 Drawing Sheets

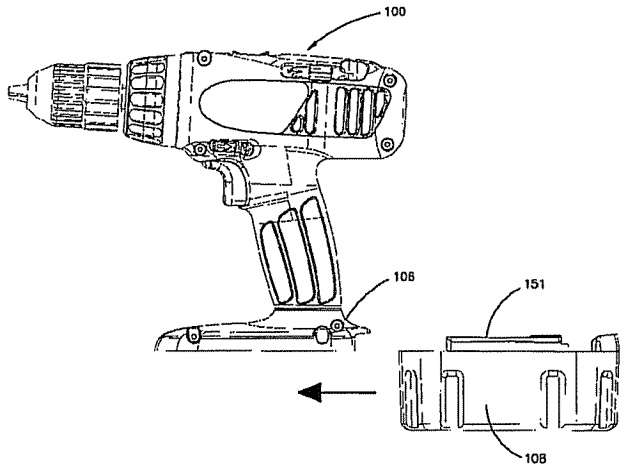

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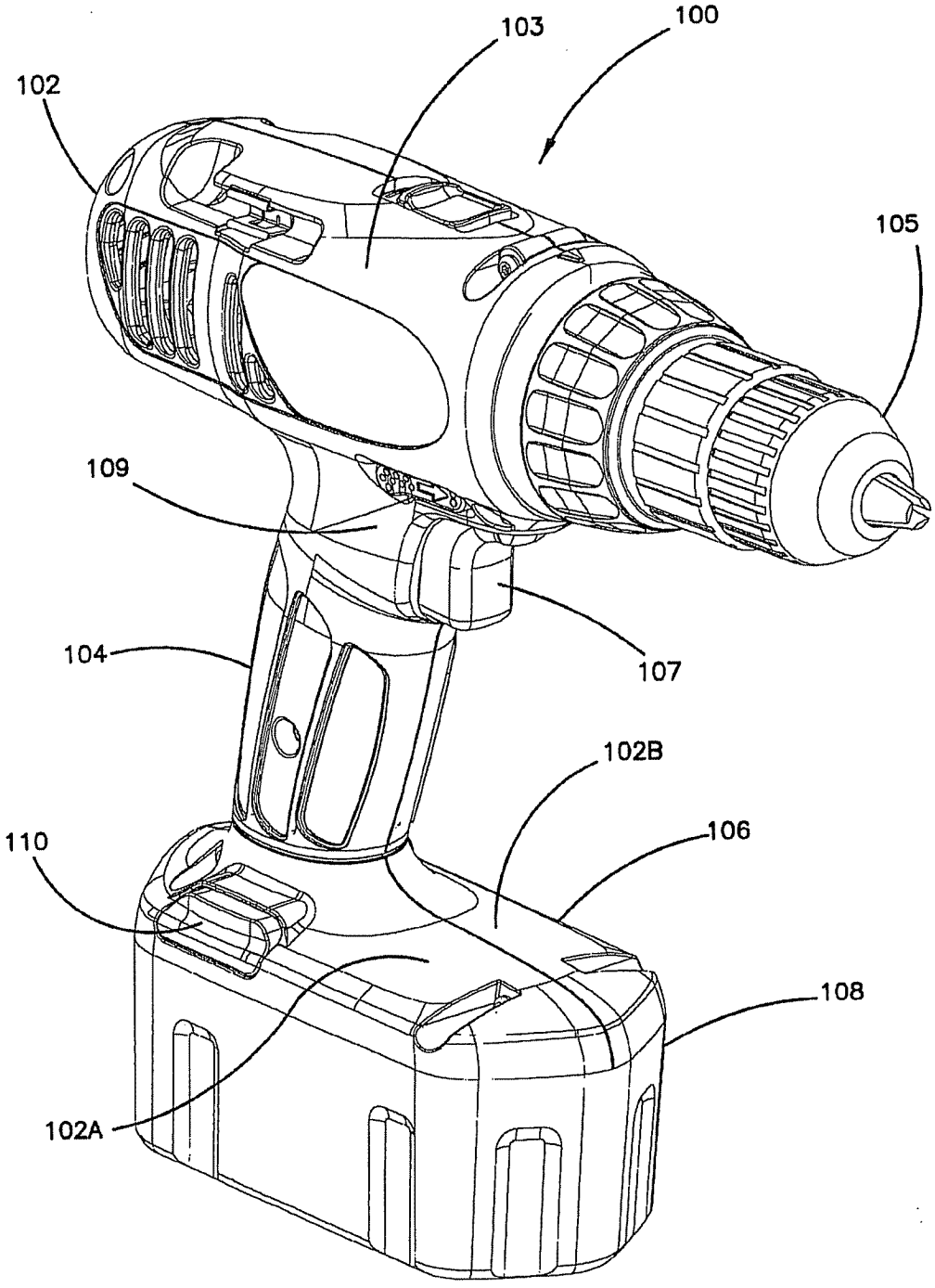
FIG. 1



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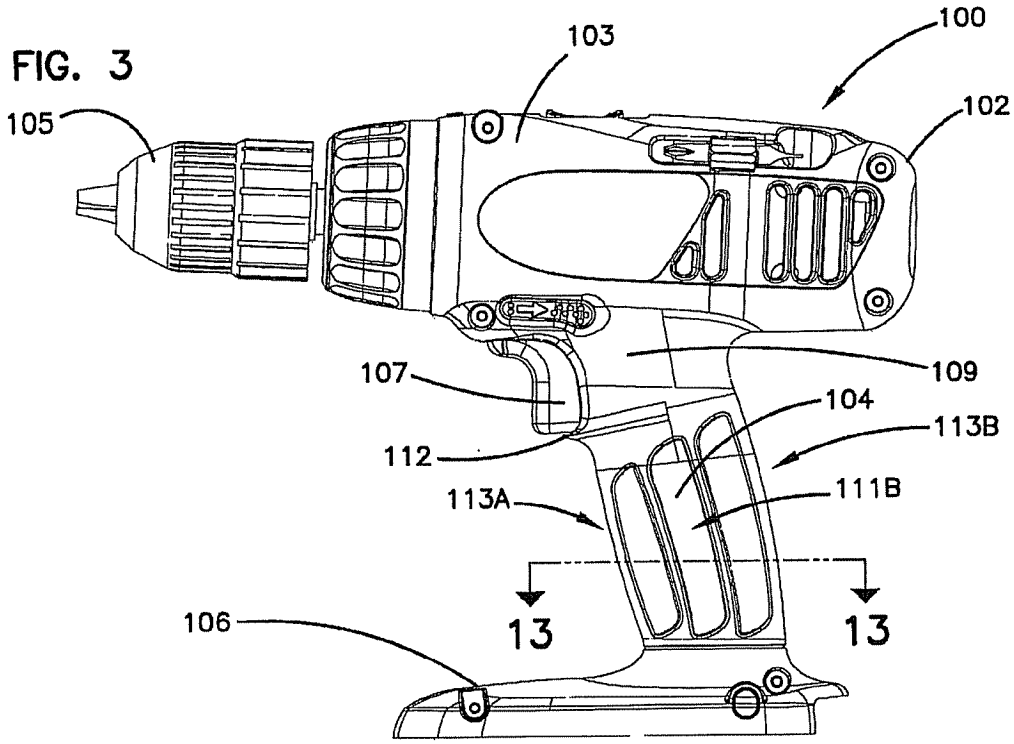
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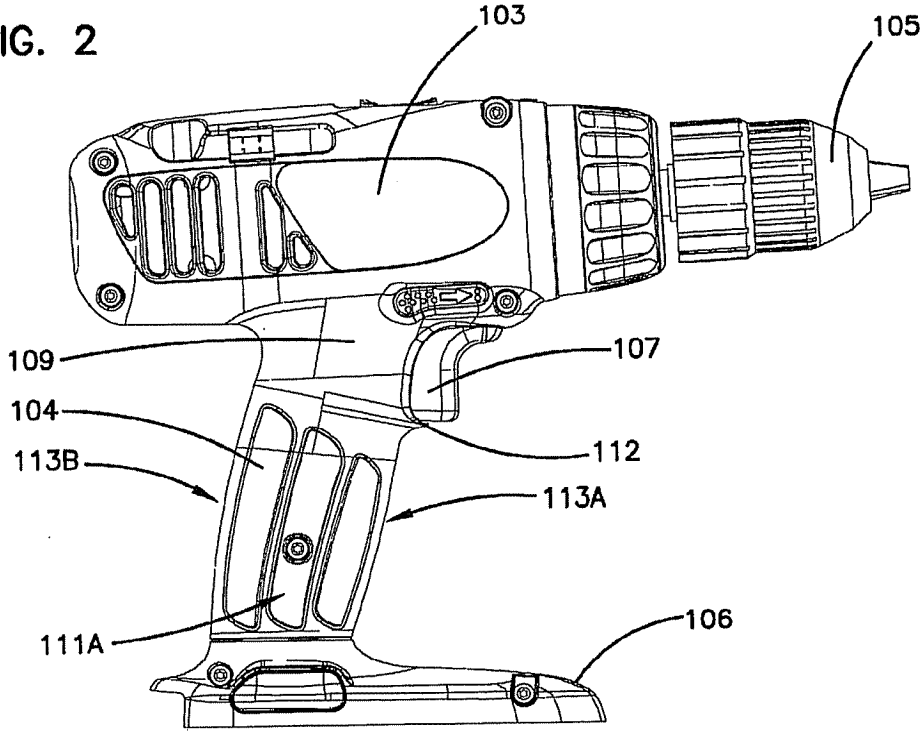
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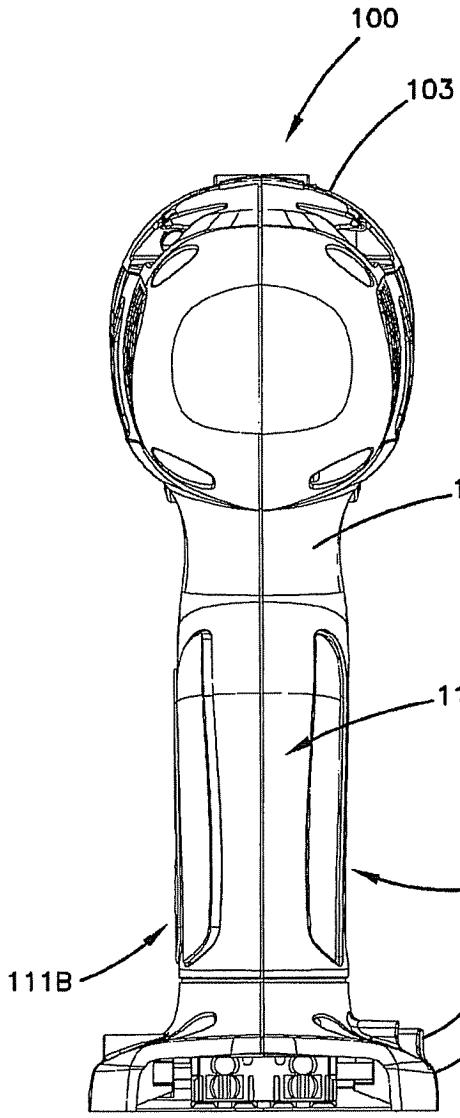
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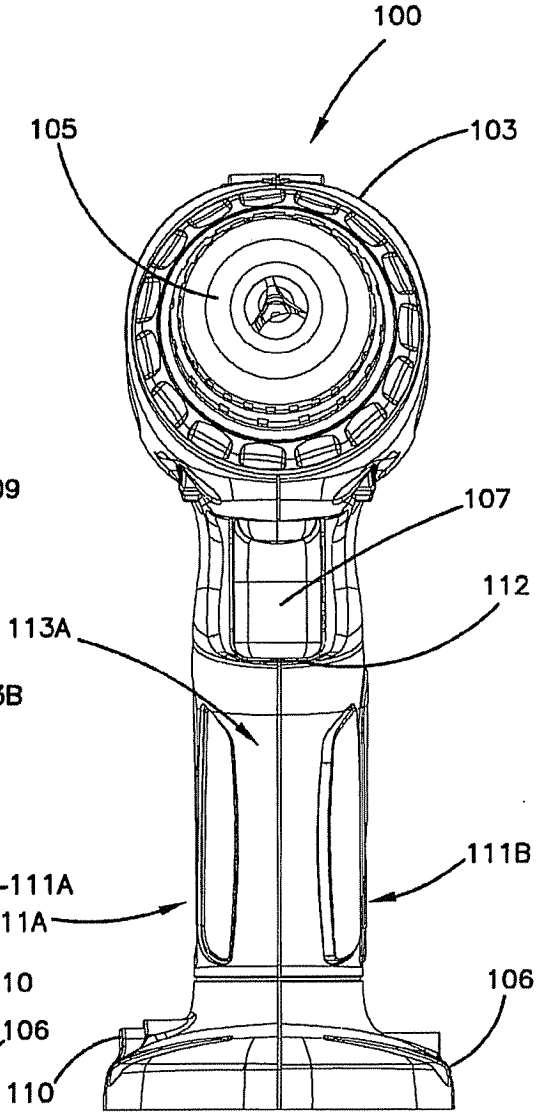
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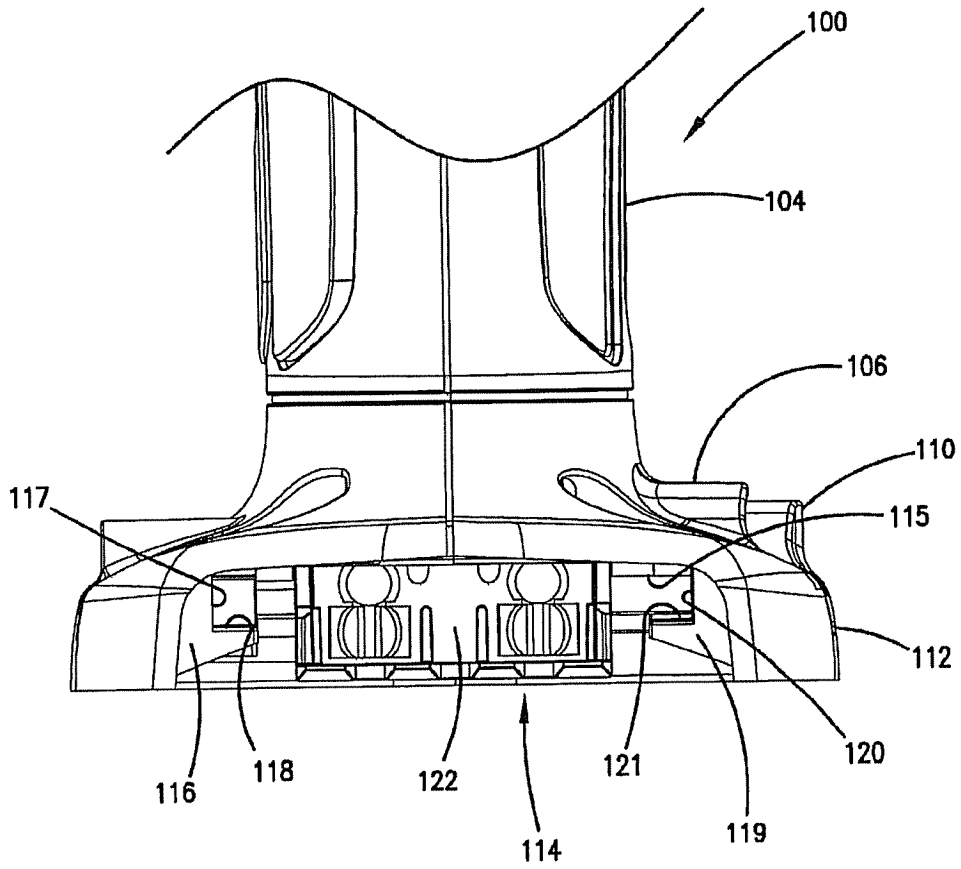
FIG. 4

FIG. 6



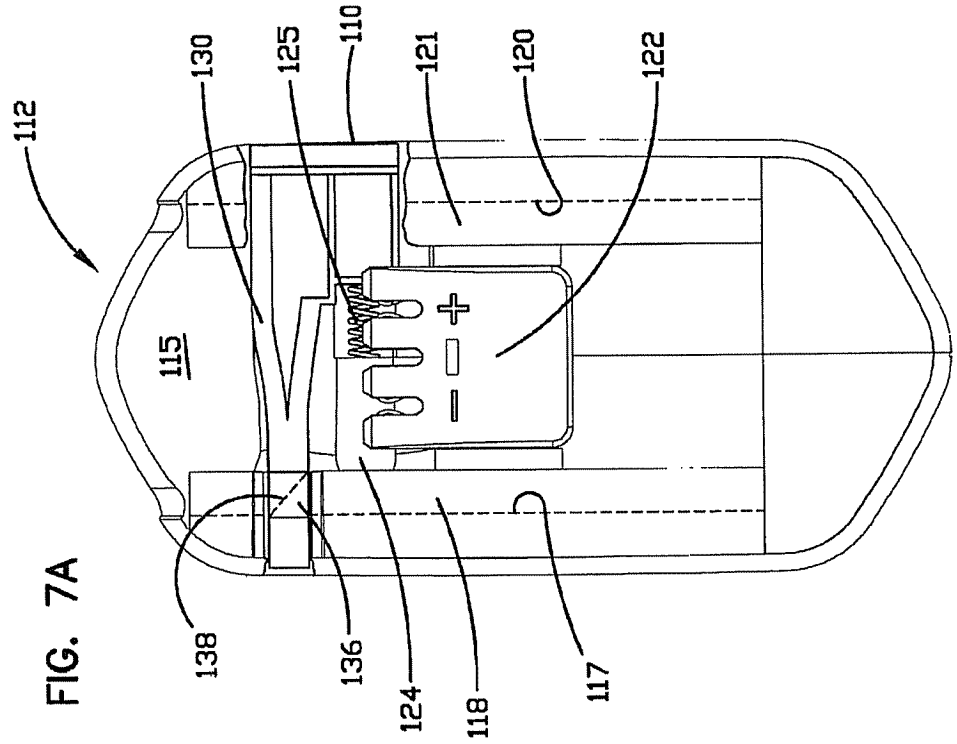

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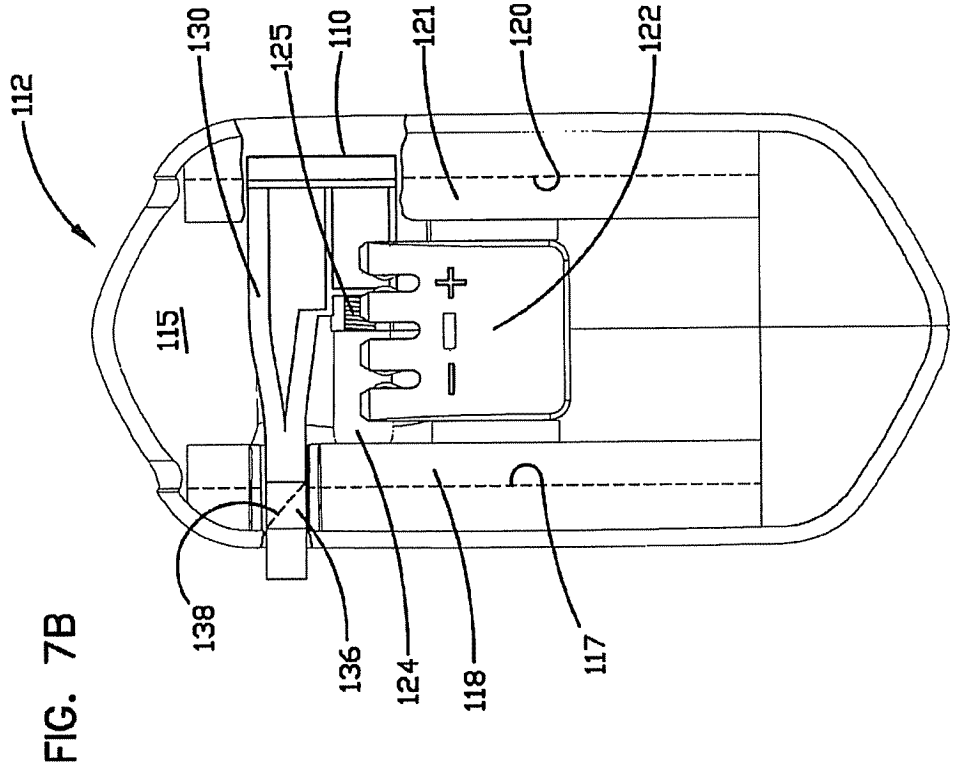
FIG. 7A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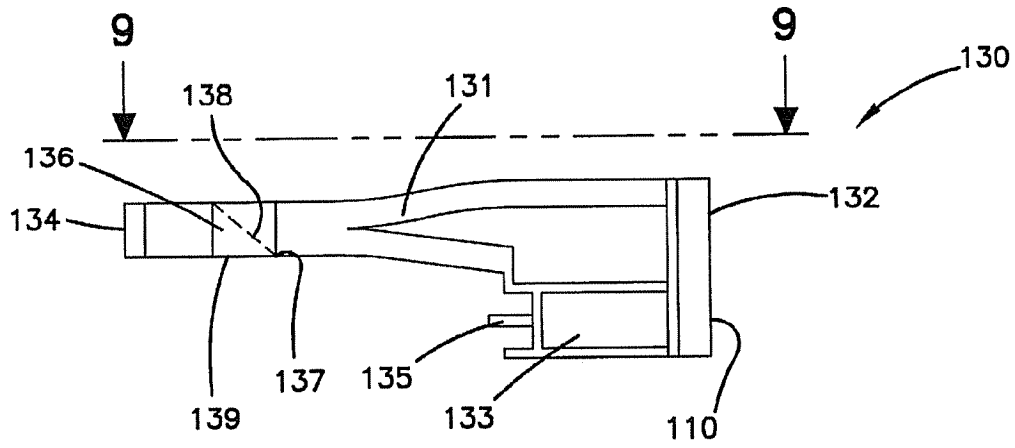
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FIG. 8

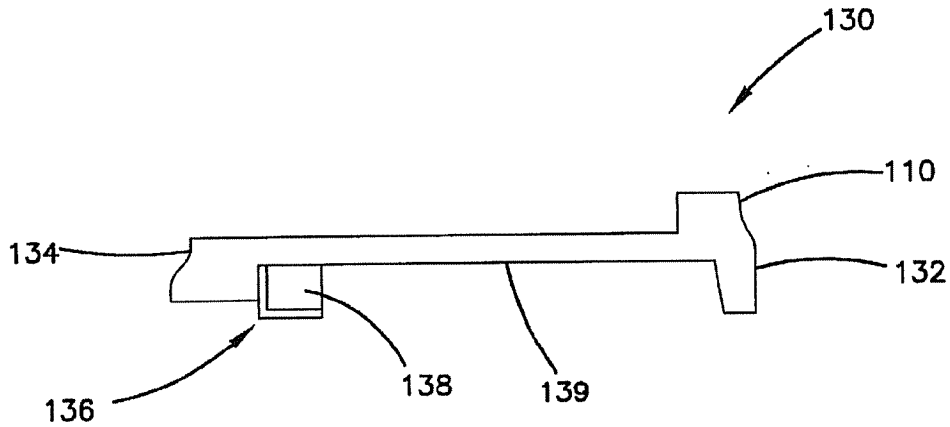
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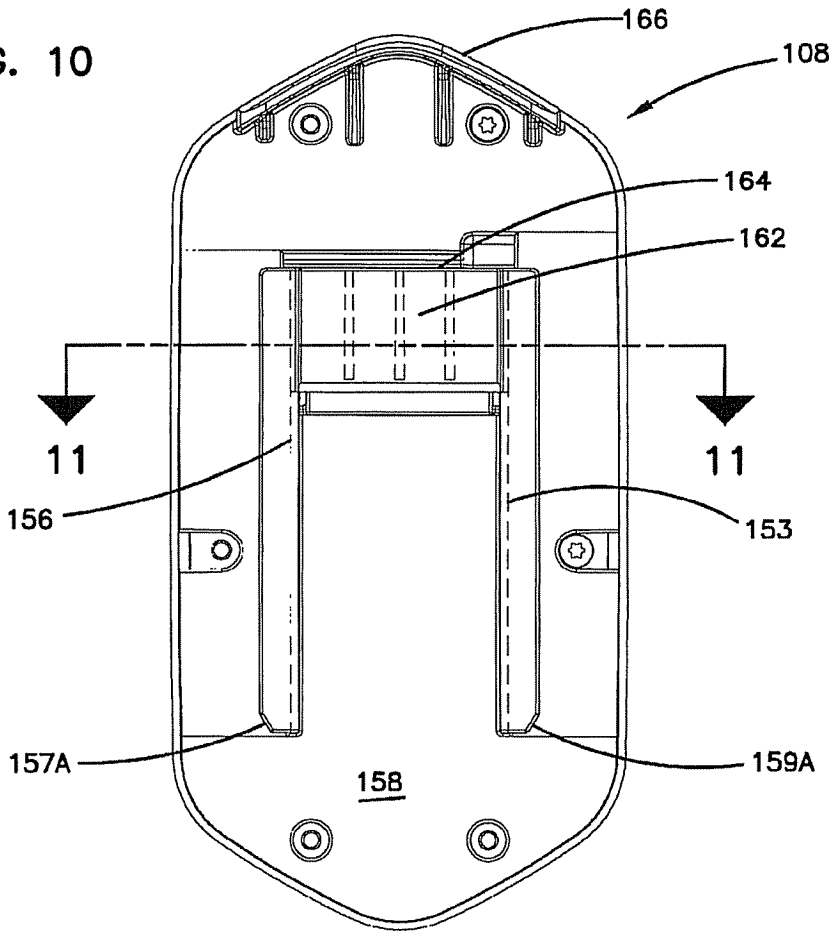
FIG. 9

FIG. 10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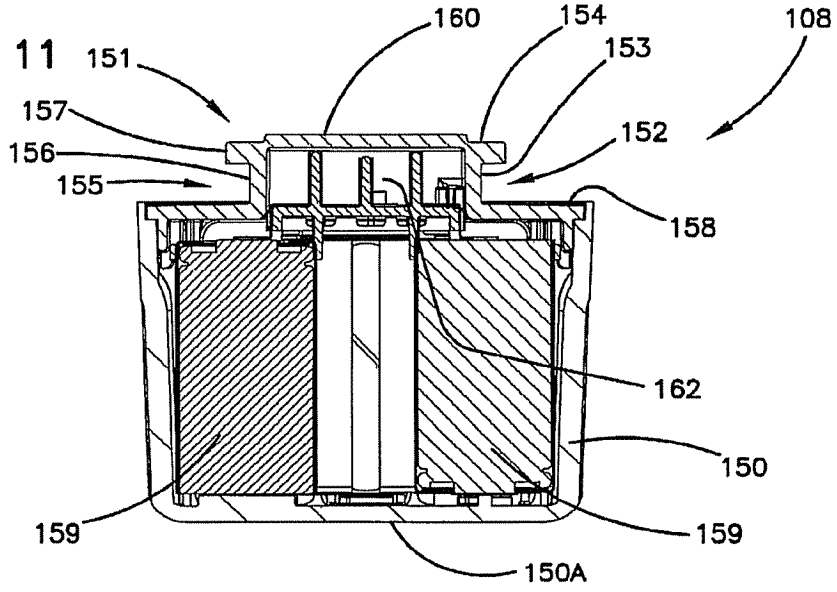
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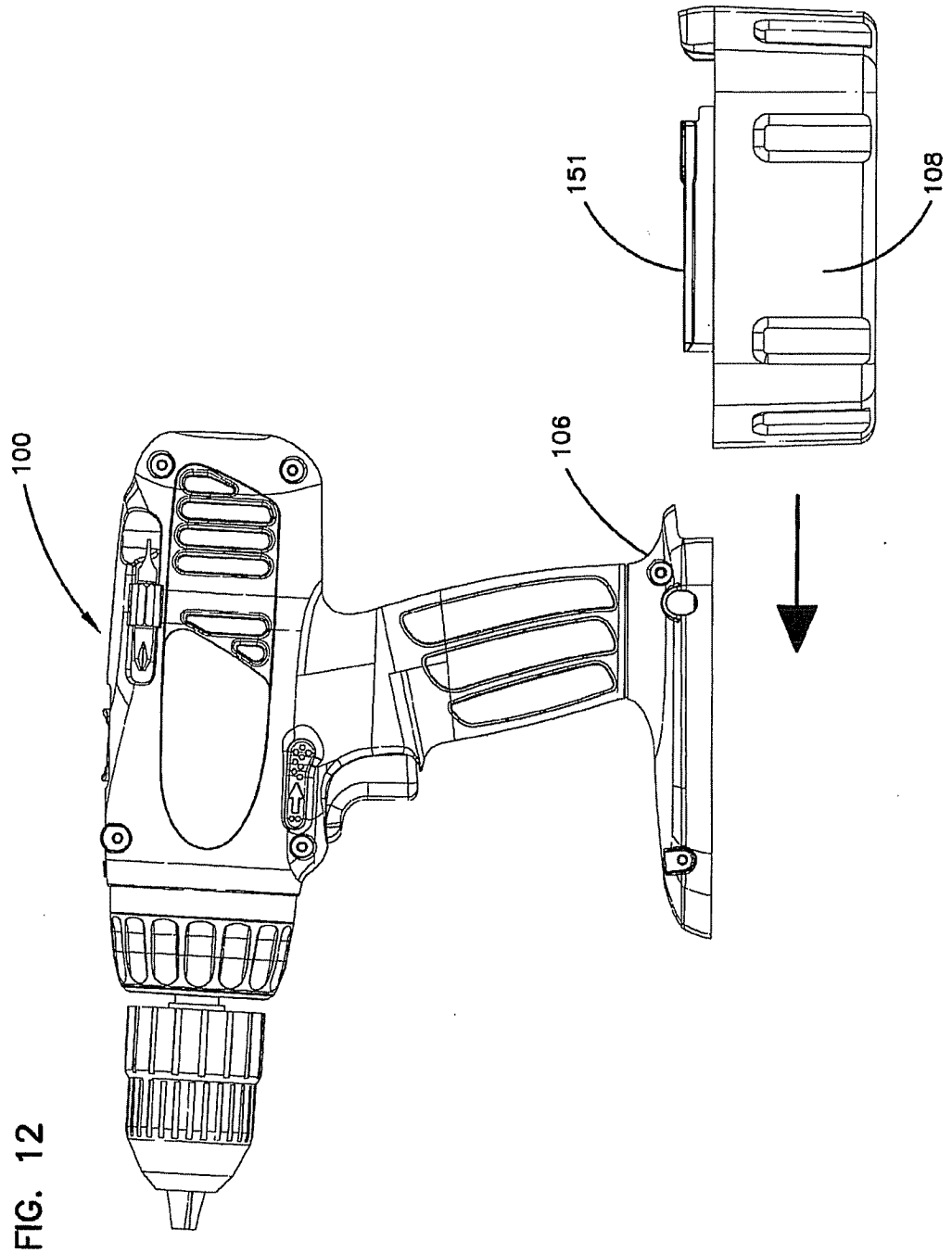

FIG. 12

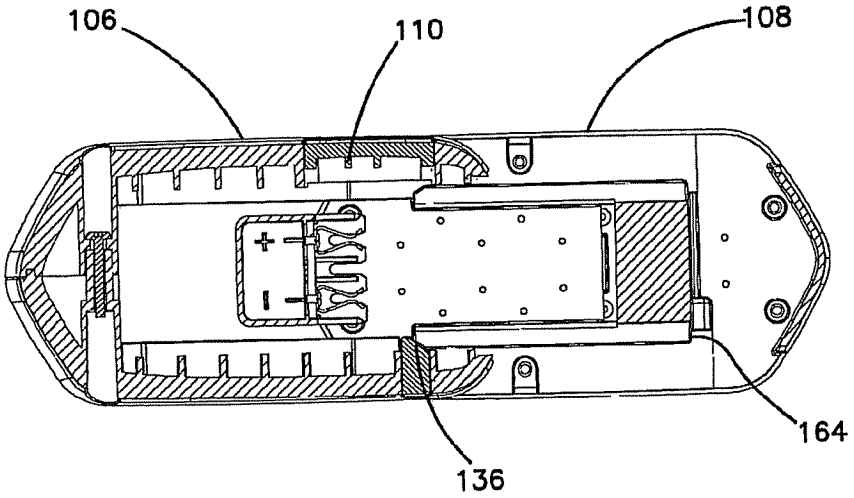

FIG. 13A

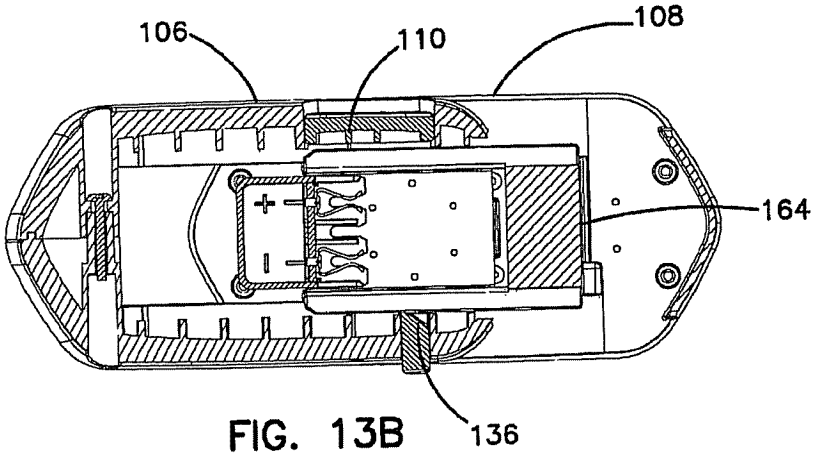

FIG. 13B

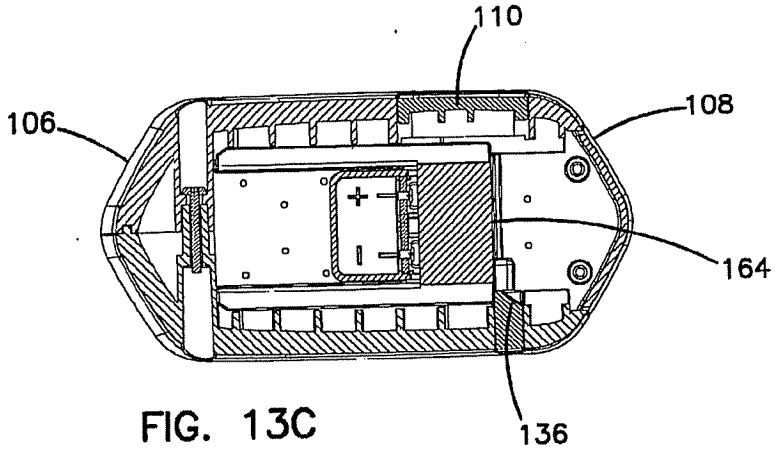

FIG. 13C

CORDLESS POWER TOOL BATTERY RELEASE MECHANISM

CLAIM FOR PRIORITY UNDER 35 U.S.C. §120

This application is a continuation-in-part and claims priority under 35 U.S.C. §120 to U.S. patent application Ser. No. 29/105,748 filed Jun. 1, 1999, now U.S Pat No. D. 435,414, entitled "BATTERY POWERED DRILL/DRIVER," the entire disclosure of which is hereby incorporated by reference.

TECHNICAL FIELD

The present invention relates to cordless power tools, and more particularly, to cordless power tools having a battery release mechanism for releasably securing a battery to the power tool.

BACKGROUND

Cordless power tools are well-known and provide several advantages over traditional corded power tools. One of the advantages provided by cordless power tools is the mobility and/or portability when using the tool. For example, the operator of the cordless power tool can quickly and efficiently work over a larger area without having to continually adjust the power cord. Similarly, cordless power tools can used in areas where electrical power is not available. Because of these advantages, the popularity of cordless power tools has increased among both professional and novice power tool users.

Despite these advantages, there are disadvantages associated with cordless power tools. One of the disadvantages associated with cordless power tools is the power limitations of the battery pack. Typically, most battery packs for cordless power tools can be operated between about 4 to 8 hours depending on the size of the battery and the amount of usage. Once the electrical charge in the battery is depleted, the operator typically is required to remove the battery pack from the power tool and recharge the battery using a battery charger.

Many existing power tools include battery release mechanisms that allow the battery to be removed from the power tool and recharged. Existing battery release mechanisms include latching arrangements that releasably secure the battery pack to the power tool. For example, some existing release mechanisms include two push buttons disposed on the side of the battery housing. In these arrangements, the battery pack extends upwards into the handle of the power tool. Thus, in order to remove the battery pack from the power tool, the user depresses both buttons and pulls downward on the battery pack to disengage the battery pack from the power tool. Other battery release mechanisms have a button disposed through the rear of the power tool. The user can release the battery pack from the power tool by depressing or sliding the button such that the latching arrangement allows removal of the battery pack.

However, there are several shortcomings with existing battery release mechanisms. For example, release mechanisms that have two buttons typically require the operator to hold the power tool and depress both buttons while trying to remove the battery pack from the power tool. Without depressing both release buttons, the battery pack is unable to be removed from the power tool. Moreover, release mechanisms having the release button disposed through the rear of the power tool typically require the operator to hold the tool differently from the way the power tool is held during operation in order to remove the battery. As a result, these battery release mechanisms are often cumbersome and difficult to use.

Improvements in the mechanisms used to releasably secure battery packs to cordless power tools are sought.

SUMMARY OF THE DISCLOSURE

The present disclosure generally relates to cordless power tools. More particularly, the present disclosure is directed towards cordless power tools having a battery release mechanism for releasably securing a battery to the power tool. The battery engages a closure member as the battery is forced into engagement with the tool from the rear.

One aspect of the invention relates to a cordless power tool having a main body portion, a handle portion depending from the main body portion and a mechanism for releasably securing a battery to the handle portion opposite the main body portion. The mechanism for releasably securing the battery to the handle portion includes a battery receiving portion integral with the handle portion and an attachment portion integral with the battery. The attachment portion is configured to engage the battery receiving portion. The mechanism also includes a closure member that is operable with and transversely disposed within the battery receiving portion. The closure member is configured to secure the battery within the battery receiving portion when the closure member is in a "lock" position. The closure member has a first end and a second end opposite the first end. The first end is disposed through a side wall of the tool housing and defines a push button for selectively moving the closure member from the "lock" position to a "release" position. When the closure member is in the "release" position, the battery can be removed from the power tool.

In yet another aspect of the invention, the closure member also includes a locking finger integral with the second end of the closure member. The locking finger is configured to secure the battery within the battery receiving portion when the closure member is in the "lock" position. Furthermore, the battery receiving portion includes a first guide channel and a second guide channel. Similarly, the attachment portion includes a first guide rail and a second guide rail. The first and second guide rails are configured to interlock with the first and second guide channels.

In an alternative aspect of the invention, the mechanism for releasably securing a battery to a power tool includes a battery receiving portion integral with the power tool housing. The battery receiving portion includes a mounting surface for receiving the battery and an attachment portion integral with the battery. The attachment portion is configured to slidably engage the battery receiving portion. Furthermore, the mechanism for releasably securing the battery to the power tool also includes a closure member that is operable with and arranged substantially perpendicular to the battery receiving portion. The closure member is configured to secure the battery within the battery receiving portion when the closure member is in a "lock" position. Conversely, the closure member is configured to disengage the battery when the closure member is in a "release" position. In this aspect of the disclosure, the closure member includes a first end and a second end opposite the first end. The closure member has an elongated body portion and a locking finger that is integral with and extends from the body portion substantially near the second end of the closure member. The locking finger is configured to secure the attachment portion to the power tool when the battery is positioned within the battery receiving portion.

In another aspect, the first end of the locking finger is disposed through a side wall of the tool housing and defines a push button for selectively moving the closure member from the "lock" position to the "release" position. The battery receiving portion includes a first guide channel and a second guide channel. Similarly, the attachment portion includes a first guide rail and a second guide rail. The first and second guide rails are configured to interlock with the first and second guide channels. The first guide rail has a first end for engaging the locking finger when the battery is moved in a first direction relative to the attachment portion. The first guide rail has a second end for engaging the locking finger when the battery is moved in a second direction relative to the attachment portion.

A method for releasably securing a battery to a power tool housing is also disclose. The method includes the steps of providing a power tool having a battery receiving portion integral with the power tool housing. The battery receiving portion is operable with a closure member that is transversely disposed within the battery receiving portion and configured to secure the battery within the battery receiving portion. The closure member has a first end and a second end. The first end of the closure member is disposed through a side wall of the tool housing and defines a push button for selectively moving the closure member from a "lock" position to a "release" position. On the battery, an attachment portion is provided that is integral with the battery and is further constructed to engage the battery receiving portion. The method further includes the steps of aligning the attachment portion with the battery receiving portion and moving the battery in a first direction such that the attachment portion slidably engages the battery receiving portion and the closure member such that the closure member is urged into the "release" position. To releasably secure the battery to power tool, the battery is positioned within the battery receiving such that the closure member returns to the "lock" position. Preferably, the attachment portion slidably engages the battery receiving portion from the rear of the power tool.

The above summary of the present invention is not intended to describe each illustrated embodiment or every implementation of the present invention. Other objects, features and advantages of the present invention will become more apparent in light of the following detailed description of exemplary embodiments thereof, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

FIG. **1** is a perspective view illustrating a power tool having a battery pack secured thereto according to the principles of the present disclosure;

FIG. **2** is a side-elevational view illustrating a first side of the power tool shown in FIG. 1;

FIG. **3** is a side-elevational view illustrating a second side of the power tool shown in FIG. 1 opposite the first side of the power tool shown in FIG. **2**;

FIG. **4** is a side-elevational view illustrating the front of the power tool shown in FIGS. **1–3**;

FIG. **5** is a side-elevational view illustrating the rear of the power tool shown in FIGS. **1–4**;

FIG. **6** is a side-elevational view illustrating the battery receiving portion from the rear of the power tool shown in FIG. **5**;

FIG. **7A** is a plan view of the bottom of the power tool shown in FIGS. **1–5** illustrating a battery release mechanism in a "lock" position;

FIG. **7B** is a plan view of the bottom of the power tool shown in FIG. **1** illustrating the battery release mechanism in a "release" position;

FIG. **8** is a plan view of a closure member for use with the battery release mechanism of the present disclosure;

FIG. **9** is a side-elevational view of the closure member shown in FIG. **8**;

FIG. **10** is a plan view of the top of a battery pack illustrating the battering receiving portion according to the principles of the present disclosure;

FIG. **11** is a side-elevational view of the battery pack shown in FIG. **10**;

FIG. **12** is an exploded, side-elevational view of the power tool shown in FIGS. **1–5** illustrating a battery in slidable engagement with the power tool; and

FIGS. **13A**, **13B**, and **13C** are cross-sectional views of the power tool of FIG. **3** taken along line **13—13** illustrating engagement of the battery of FIGS. **10** and **11** with the power tool of FIGS. **1–5**.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION

The present disclosure generally relates to cordless power tools. More particularly, the present disclosure is directed towards cordless power tools having a battery release mechanism for releasably securing a battery to the power tool. While the present invention is not so limited, a more detailed understanding of the present invention will be gained through a discussion of the drawings in connection with the examples provided below.

Referring now to FIG. **1**, there is illustrated a cordless electric power tool **100**. By way of illustration, the power tool **100** shown in FIG. **1** is an electric power drill/driver. However, it should be understood that the present invention is generally applicable to a variety of power tools, including cordless circular saws, cordless reciprocating saws, planars, flashlights, as well as other cordless tools having a rechargeable battery pack secured thereto.

The power tool **100** has a housing **102** that is preferably molded from a suitable plastic material, such as polyethylene, polypropylene, or polyurethane. In a preferred embodiment, the power tool housing **102** is injection molded having two halves portions **102A**, **102B**. The two halve portions **102A**, **102B** are secured together in a conventional manner using mechanical fasteners (not shown), such as screws. The tool housing **102** includes a generally tubular and elongated main body portion **103**. An electric motor (not shown) is disposed within the body portion **103**. The electric motor is electrically coupled to a battery pack **108** that provides the electrical energy to power the electric motor. Furthermore, the electric motor is mechanically coupled to an output shaft **105** that can be configured to operate with various tool accessories. For example, the output shaft **105** is a conventional drill chuck that can be configured to

operate with tool accessories, such as, drill bits, drivers, or other accessories.

The tool housing **102** also includes a handle portion **104** that extends downwardly from the main body portion **103**. By "downwardly," it is meant that in the orientation of the power tool **100** shown in FIG. 1, the handle portion **104** extends below the main body portion **103** of the power tool **100**. The handle portion **104** is configured and arranged to allow a user to easily grip and maneuver the power tool **100** during operation. As shown in FIGS. **2–5**, the handle portion **104** includes a first side region **111**A, a second side region **111**B opposite the first side region **111**A. Additionally, the handle portion **104** includes a front region **113**A connecting the first and second side regions **111**A, **111**B along the front of the power tool, and a rear region **113**B connecting the first and second side regions **111**A, **111**B along the rear of the power tool **100**. In the embodiment shown in FIGS. **2–5**, the first side region **111**A is the "right-hand" side of the handle portion **104** and the second side region **111**B is the "left-hand" side of the handle portion **104**.

The power tool housing **102** also defines a trigger receiving portion **109** disposed between the main body portion **103** and the handle portion **104**. More particularly, the trigger receiving portion **109** is disposed between the main body portion **103** and the front region **113**A. The trigger receiving portion **109** is sized and configured to allow the operator to engage a trigger **107** disposed through the trigger receiving portion **109**. Moreover, the trigger receiving portion **109** defines a ridge **112** that separates the trigger receiving portion **109** from the handle portion **104**. The ridge **112** assists the operator in properly aligning his hand on the handle portion **104** when operating the power tool **100**. For example, when the operator is gripping the power tool **100**, the operator typically uses his trigger finger (eg. the operator's forefinger) to actuate the trigger **107**. While the operator's trigger finger is positioned over the trigger receiving portion **109**, the ridge **112** ensures that the operator's other fingers are positioned below the trigger **107** and are, therefore, unable to actuate the trigger **107**.

Referring again to FIG. **1**, the power tool **100** also includes a support portion **106** that is integral with the handle portion **104**. The support portion **106** is generally flat and elongated and extends in a direction substantially parallel to the elongated main body portion **103**. The support portion **106** stabilizes the power tool **100** when resting on a flat surface in an upright position as shown in FIG. 1. As will be described in greater detail below, a battery pack **108** is releasably secured to the support portion **106** of the power tool **100**. In one embodiment, the battery **108** can be released from the power tool **100** by depressing the button **110** which is disposed through a side of the handle portion **104**.

Referring now to FIG. **6**, a side elevational view illustrating the rear of the power tool **100** is shown. As can be seen, the support portion **106** depends from and is integral with the handle portion **104**. The support portion **106** includes a battery receiving portion **112**. The battery receiving portion **112** is sized and configured to slidably receive the battery **108** (FIG. 1) through the opening **114**. The battery receiving portion **112** is capable of accommodating any size battery **108** that is capable of operating the cordless power tool **100**. For example, the battery **108** can be a 12 volt, 14.4 volt or a 19.2 volt battery or any other size battery capable of operating the cordless power tool **100**. The battery receiving portion **112** includes a first guide channel **116** and a second guide channel **119**. The first guide channel **116** is generally "L-shaped" and includes an upright member **117** depending from the mounting surface **115**. A flange member **118** extends laterally from and substantially perpendicular to the upright member **117**. Similarly, the second guide member **119** is also generally "L-shaped" and includes an upright member **120** depending from and substantially perpendicular to the mounting surface **115**. A flange member **121** extends laterally from and substantially perpendicular to the upright member **120**. Additionally, electrical terminals or contacts **122** depend from the mounting surface **115** and are disposed within the battery receiving portion **112**. Preferably, the electrical terminals or contacts **122** are substantially centered between the first and second guide channels **116**, **119**. The electrical terminals **122** are situated to engage the battery terminals **162** integral with the battery **108** discussed below in connection with FIGS. **10** and **11**.

Referring now to FIG. **7**A, a bottom plan view of the power tool **100** is shown illustrating the battery release mechanism according to the principles of the present disclosure. As can be seen, the first guide channel **116** is substantially parallel to the second guide channel **119**:. Further, the first and second guide channels **116**, **119** are situated along the length of the mounting surface **115** and are spaced apart a lateral distance. As discussed above, the first and second guide channels **116**, **119** are constructed and arranged to receive the battery **108** (FIG. 1).

The battery release mechanism includes a generally elongated closure member **130** that is situated within the battery receiving portion **112** substantially perpendicular to the first and second guide channels **116**, **119**. As shown in FIGS. **8** and **9**, the closure member **130** has a first end **132** and a second end **134**. The first end **132** is disposed through a side wall of the power tool housing **100** and defines a push button **110** that allows a user to selectively move the closure member **130** from a "lock" position to a "release" position. In one embodiment, the push button **110** is disposed through the first side region **111**A of the handle portion **104**. Alternatively, the push button **110** can be disposed through the second side region **111**B of the handle portion **104**. Thus, an operator can easily and efficiently release the battery **108** from the power tool **100** by depressing a single button **110** disposed through a side region of the power tool **100**.

Additionally, as shown in FIG. **9**, the elongated closure member **130** also includes a locking finger **136** at or substantially near the second end **134**. The locking finger **136** is constructed and arranged to selectively obstruct the first guide channel **116**. As shown in FIG. **8**, the locking finger **136** includes an angled or chamfered surface **138** and a rear edge surface **139** that converge at the tip **137**. In one embodiment, the locking finger **136** obstructs at least a portion of the first guide rail **116** when the closure member **130** is disposed within the battery receiving portion **112** and in the "lock" position. By "obstruct," it is meant that the tip **137** of the locking finger **136** extends beyond the upright member **117** of the first guide rail **116**. In the embodiment shown in FIG. **6**, the tip **137** of the locking finger **136** is substantially coplanar with the tip **118**A of the laterally extending flange member **118**. Conversely, when the closure member **130** is in the "release" position as shown in FIG. **7**B, the locking finger **136** no longer obstructs the first guide channel **116**. Instead, the tip **137** of the locking finger **136** is substantially coplanar with the upright member **117**. In the embodiment shown in FIG. **7**B, the tip **137** of the locking finger **136** is substantially coplanar with the upright member **117**.

A post **135** extends from a lower portion **133** of the closure member **130** as shown in FIGS. **7**A, **7**B, and **8**. The post **135** is sized and configured to receive a spring **125**, such as a helical coil compression spring. The spring **125** biases

the closure member **130** in the "lock" position. For example, when the closure member **130** is disposed within the battery receiving portion **112**, the spring **125** biases the closure member **130** into the "lock" position such that the locking finger **136** obstructs at least a portion of the first guide channel **116** as discussed above. Conversely, when the push button **110** is depressed, the spring **125** is compressed as the closure member **130** is moved from the "lock" position to the "release" position.

As discussed above, the battery receiving portion **112** is constructed and arranged to receive and secure the battery **108** within the battery receiving portion **112**. Referring now to FIGS. **10** and **11**, the battery **108** includes a main body portion **150**. The main body portion **150** has a flat bottom surface **150**A that allows the power tool **100** to remain in an upright position as shown in FIG. 1 when the battery **108** is secured to the power tool **100**.

An attachment portion **151** opposite the bottom surface **150**A is provided to engage with the battery receiving portion **112** of the power tool **100**. In a preferred embodiment, the attachment portion **151** is substantially centered on the attachment surface **158**. The attachment portion **151** includes a first guide rail **152** and a second guide rail **155**. The first guide rail **152** is a generally "L-shaped" and includes an upright member **153** extending upwards and substantially perpendicular from the attachment surface **158** and opposite the bottom surface **150**A. A flange member **154** extends laterally from and substantially perpendicular to the upright member **153**. The second guide rail **155** is also generally "L-shaped" and also includes an upright member **156** extending upwards and substantially perpendicular from the attachment surface **158** and opposite the bottom surface **150**A. A flange member **157** extends laterally from and substantially perpendicular to the upright member **156**. A rear edge **164** extends between and connects the first and second guide rails **152**, **155**.

The first and second guide rails **152**, **155** are constructed and arranged to engage and interlock with the first and second guide channels **116**, **119**, respectively. By "interlock," it is meant that the first and second guide rails **152**, **155** cooperate with the first and second guide channels **116**, **119** to allow the battery **108** to slidably engage with the power tool **100**. To facilitate this, the flange member **154** of the first guide rail **152** has a chamfered or beveled leading edge **154**A. Similarly, the flange member **157** of the second guide rail **155** has a chamfered or beveled leading edge **157**A. The chamfered or beveled leading edges **154**A, **157**A allows easier alignment and interlocking between the first and second guide rails **152**, **155** and the first and second guide channels **116**, **119**.

The battery terminals **162** are disposed within the attachment portion **151** of the battery **108**. The battery terminals **162** are electrically coupled to the battery cells **159** disposed within the main body portion **150** of the battery **108**. The battery terminals **162** are constructed and arranged to engage the battery contacts **122** disposed within the battery receiving portion **112**. Accordingly, electrical communication is provided between the battery terminals **162** and the battery contacts **122** when the battery **108** is releasably secured to the power tool **100** according to the present disclosure. Furthermore, the battery **108** also includes a sealing member **166** that seals the opening **114** once the battery **108** is releasably secured to the power tool **100**.

In operation, the battery **108** can be releasably secured to the power tool **100** by bringing the attachment portion **151** of the battery **108** into engagement with the battery receiving portion **112** of the power tool **100**. Preferably, as shown in FIG. **12** the battery **108** is brought into engagement with the power tool **100** from the rear. This is accomplished by first aligning the attachment portion **151** with the opening **114** of the battery receiving portion **112**. As shown in FIG. **13**A, after aligning the attachment portion **151** with the battery receiving portion **112**, the battery **108** can be slid into the tool housing **102** such that the first guide rail **152** engages the first guide channel **116** and the second guide rail **155** engages the second guide channel **119**. For example, FIG. **13**A shows the battery receiving portion **112** and the attachment portion **154**A in initial engagement. Thus, the leading edge **154**A is in physical engagement with the locking finger **136** that obstructs at least a portion of the first guide channel **116**.

As the attachment portion **151** is slid into engagement with the battery receiving portion **112**, the first and second guide rails **152**, **155** are allowed to interlock with the first and second guide channels **116**, **119**. As discussed above, the closure member **130** is biased into the "lock" position such that the locking finger **136** obstructs at least a portion of the first guide channel **116**. However, as shown in FIG. **13**B, as the battery **108** is slidably moved into engagement with the battery receiving portion **112**, the first guide rail **152** engages the closure member **130** and urges the closure member **130** into the "release" position. For example, the first guide rail **152** urges the locking finger **136** out of the first guide channel **116** such that the tip **137** is substantially coplanar with the upright member **117** of the first guide channel **116**. In a preferred embodiment, the flange member **153** of the first guide rail **152** has a chamfered leading edge **153**A that engages the angled or chamfered surface **138** of the locking finger **136** as the first guide rail **152** slidably engages the first guide channel **116**. Accordingly, the resistance of the locking finger **136** to be moved from the guide channel **116** is reduced. The battery **108** is moved further into the battery receiving portion **112** until the rear edge **164** of the attachment portion **151** moves beyond the rear edge **139** of the locking finger **136** as shown in FIG. **13**C. In this position, the first guide rail **152** no longer urges the locking finger out of the first guide channel **116** and therefore, the closure member **130** is allowed to return to the "lock" position. In this position, the battery **108** is secured to the power tool **100**.

An operator can release the battery **108** from the power tool **100** by depressing the push button **110** and urging the battery **108** in a direction towards the rear of the power tool **100**. Preferably, the push button **110** is disposed through the side of the power tool housing **102** and can be depressed by the operator using the same hand that urges the battery **108** away from the power tool **100**. By depressing the push button **110**, the closure member **130** is urged from the "lock" position to the "release" position. In the "release" position, the locking finger **136** of the closure member **130** no longer obstructs the first guide channel **116**. Thus, the rear edge **164** of the attachment portion **151** no longer prevented from movement by the rear edge **139** of the locking finger **136**. As a result, the battery **108** can be easily removed from the battery receiving portion **112** of the power tool **100** by depressing a single button **110** disposed through a side region of the power tool **100** and pulling the battery **108** from the power tool **100**.

The operator can maintain a firm grip on the handle portion **104** with a first hand while gripping the battery **108** and depressing the push button **110** with a second hand. Preferably, the first hand of the operator grips the handle portion **104** of the power tool **100** similar to the way the power tool **100** is held during operation. A second hand of

the operator grips the battery while depressing the button **110** and pulling the battery **108** from the power tool **100**. Alternatively, the operator can depress the button **110** with a finger of the first hand holding the handle portion **104** while pulling the battery **108** from the power tool **100**. In either case, the operator can easily and efficiently remove the battery **108** from the power tool **100**.

The above specification and embodiments are believed to provide a complete description of the manufacturer and use of particular embodiments of the invention. Many embodiments of the invention can be made without departing from the spirit and scope of the invention, which is limited by the attached claims.

We claim:

1. A cordless power tool including a battery, the power tool comprising:

(a) a main body portion;

(b) a handle portion extending from the main body portion; and

(c) a mechanism for releasably securing a battery having battery terminals to the handle portion, the mechanism including:

(i) a battery receiving portion integral with the handle portion, the battery receiving portion having at least one guide channel and battery contacts disposed therein;

(ii) a battery having an attachment portion integral with the battery, the attachment portion having at least one guide rail and being constructed and arranged for engaging the battery receiving portion such that

a. the battery terminals engage the battery contacts, and

b. the at least one guide channel and the at least one guide rail interlock;

(iii) a closure member operable with and transversely disposed at least partially within the battery receiving portion and configured to secure the battery within the battery receiving portion, the closure member having a lock position and a release position, the closure member including first and second opposite ends, the first end being exposed through a wall of the tool housing and defining a moveable release arrangement that has a push button for selectively moving the closure member from the lock position to the release position when the push button is depressed, thereby allowing the battery to be easily removed from the power tool.

2. The power tool of claim **1**, the closure member further comprising a locking finger integral with the second end, the locking finger being constructed and arranged for securing the battery within the battery receiving portion when the closure member is in the lock position.

3. The power tool of claim **1**, wherein:

(a) the battery receiving portion includes first and second guide channels; and

(b) the attachment portion comprises first and second guide rails being constructed and arranged for interlocking with the first and second guide channels.

4. The power tool of claim **3**, the closure member further comprising a locking finger integral with the second end, the locking finger being constructed and arranged for securing the guide rails within the guide channels when the battery is positioned within the battery receiving portion and the closure member is in the lock position.

5. The power tool of claim **4**, wherein the locking finger has a chamfered surface constructed and arranged to engage with the first guide rail of the attachment portion such that the closure mechanism is moved to the release position.

6. The power tool of claim **4**, wherein the locking finger obstructs at least a portion of the first guide channel when the closure member is in the lock position.

7. The power tool of claim **4**, wherein the locking finger is removed from the first guide channel when the closure member is in the release position.

8. The power tool of claim **1**, wherein the closure member is spring biased in the lock position.

9. The power tool of claim **1**, wherein:

(a) the power tool has a rear; and

(b) the attachment portion slidably engages the battery receiving portion from the rear of the power tool.

10. The cordless power tool of claim **1**, wherein the second end of the closure member protrudes from a side wall of the battery receiving portion when the push button is depressed allowing the battery to be removed from the power tool.

11. The cordless power tool of claim **10**, wherein the push button is depressed inward relative to the battery receiving portion.

12. The cordless power tool of claim **11**, wherein the closure member compresses a spring when the second end of the closure member protrudes from the side wall of the battery receiving portion.

13. The cordless power tool of claim **11**, wherein the second end of the closure member does not protrude from the side wall of the battery receiving portion when the closure member is in the lock position.

14. A mechanism for releasably securing a battery having battery terminals to a power tool housing, the mechanism comprising:

(a) a battery receiving portion integral with the power tool housing, the battery receiving portion having battery contacts disposed therein and further having at least one guide channel;

(b) an attachment portion integral with the battery, the attachment portion having at least one guide rail and being constructed and arranged for engaging the battery receiving portion such that the battery terminals engage the battery contacts and the at least one guide channel and the at least one guide rail interlock;

(c) a closure member operable with and arranged substantially perpendicular to the battery receiving portion and configured to secure the battery within the battery receiving portion when the closure member is in a lock position and to disengage the battery when the closure member is in a release position, the closure member including:

(i) first and second opposite ends;

(ii) a body portion;

(iii) a locking portion integral with and extending from the body portion substantially near the second end of the closure member, the locking portion being constructed and arranged for releasably securing the battery within the battery receiving portion when the battery is positioned within the battery receiving portion,

wherein the first end of the closure member is disposed through a side wall of the battery receiving portion and defines a push button for selectively moving the closure member from the lock position to the release position when the push button is depressed.

15. The mechanism of claim **14**, wherein

(a) the battery receiving portion includes first and second guide channels having an upright member extending

from the mounting surface and a flange member extending substantially perpendicular from the distal end of the upright member; and

(b) the attachment portion comprises first and second guide rails being constructed and arranged for interlocking with the first and second guide channels, the guide rails having a first end for engaging the locking finger when the battery is moved in a first direction relative to the attachment portion, and a second end for engaging the locking finger when the battery is moved in a second direction relative to the attachment portion.

16. The mechanism of claim **15**, wherein the locking finger includes a chamfered surface constructed and arranged to engage with the first guide rail of the attachment portion such that the closure mechanism is moved to the release position.

17. The mechanism of claim **16**, wherein the locking finger further includes an occluding surface opposite the chamfered surface, the occluding surface being constructed and arranged to obstruct at least a portion of the first guide channel when the closure member is in the lock position.

18. A method of releasably securing a battery to a power tool housing comprising the steps of:

(a) providing a battery receiving portion integral with the tool housing and being configured with at least one guide channel, the battery receiving portion being operable with a closure member at least partially disposed transversely within the battery receiving portion, the closure member having first and second opposite ends, the first end being exposed through a wall of the tool housing and defining a finger engaging portion for selectively moving the closure member from a lock position to a release position, the closure member being movably biased in the lock position, the first end defining a push button;

(b) providing an attachment portion integral with the battery, the attachment portion being constructed and arranged for engaging the battery receiving portion, the attachment portion having at least one guide rail;

(c) aligning the attachment portion with the battery receiving portion;

(d) moving the battery in a direction such that the attachment portion slidably engages the battery receiving portion;

(e) wherein the at least one guide channel in the battery receiving portion and the at least one guide rail on the attachment portion interlock;

(f) positioning the battery within the battery receiving portion such that the closure member moves away from the lock position and then, once the battery is inserted fully, to the lock position, thereby securing the battery to the power tool;

(g) depressing the push button such that the closure member moves from the lock position to the release position; and

(h) moving the battery in a second direction such that the attachment portion disengages from the battery receiving portion.

19. The method of claim **18**, wherein:

(a) the step of providing a battery receiving portion integral with the tool housing includes proving a battery receiving portion having first and second guide channels;

(b) the step of providing an attachment portion integral with the battery includes providing an attachment portion having first and second guide rails being constructed and arranged for interlocking with the first and second guide channels; and

(c) the step of aligning the attachment portion with the battery receiving portion further includes aligning the first and second guide rails with the first and second guide channels.

20. The method of claim **19**, wherein:

(a) the step of providing a battery receiving portion operable with a closure member includes providing a closure member having a locking finger integral with the second end of the closure member; and

(b) the step of moving the battery in a first direction further includes moving the battery in a first direction such that the first and second guide rails slidably engage the first and second guide channels and the locking finger such that the closure member is urged into the release position.

21. The method of claim **18**, wherein:

(a) the power tool has a rear; and

(b) the step of moving the battery in a first direction includes moving the battery in a first direction such that the attachment portion slidably engages the battery receiving portion from the rear of the power tool.

22. A cordless power tool comprising a battery, the power tool comprising:

(a) a battery receiving portion, integral with the power tool and having at least one guide channel;

(b) an attachment portion, integral with the battery and having at least one guide rail, wherein the at least one guide channel in the battery receiving portion interlocks with the at least one guide rail on the attachment portion; and

(c) a closure member operable with and transversely disposed in relation to said battery receiving portion and attachment portion for releasably securing the battery in the power tool,

wherein an end of the closure member defines a push button for selectively moving the closure member from a lock position to a release position when the push button is depressed.

23. The cordless power tool of claim **22**, wherein:

the battery receiving portion provides at least two guide channels;

the attachment portion provides at least two guide rails; and

the at least two guide channels in the battery receiving portion interlock with the at least two guide rails on the battery.

24. A cordless power tool comprising a battery, the power tool comprising:

(a) a battery receiving portion, integral with the power tool;

(b) an attachment portion, integral with the battery, that attaches to the battery portion; and

(c) a closure member for securing the attachment portion to the battery receiving portion, the closure member having a push button on a first end and an opposing second end, wherein depressing the push button inward relative to the battery receiving portion permits the attachment portion to be released from the battery receiving portion,

wherein when the push button is depressed the second end of the closure member protrudes from the battery receiving portion.

25. The power tool of claim 24, wherein when the push button is not depressed, the second end of the closure member does not protrude from the battery receiving portion.

26. The power tool of claim 24, wherein a locking finger is located proximate the second end of the closure member.

27. The power tool of claim 24, wherein the battery receiving portion has at least one guide channel and the attachment portion has at least one guide rail, wherein the at least one guide channel in the battery receiving portion interlocks with the at least one guide rail on the attachment portion.

28. The power tool of claim 27, wherein the at least one guide rail has a chamfered leading edge to facilitate interlocking.

29. The power tool of claim 28, wherein a finger lock is located proximate the second end of the closure member, the locking finger having a chamfered surface.

30. The power tool of claim 24, wherein the attachment portion enters in engagement with the battery receiving portion on a rear side of the power tool, the push button is located at a side of the power tool that is not the rear side of the power tool, and the closure member moves transversely with respect to the battery receiving portion.

31. The power tool of claim 24, wherein the first end is wider than the second end.

32. The power tool of claim 24, wherein the closure member has a unitary body.

33. The power tool of claim 24, wherein the battery has an axis of major extension which is substantially parallel to an axis of major extension of a handle of the power tool.

34. The power tool of claim 24, wherein the power tool has an accessory.

35. The power tool of claim 34, wherein the accessory is a driver.

36. The power tool of claim 34, wherein the accessory is a drill bit.

37. The power tool of claim 24, wherein the battery is a rechargeable battery.

38. The power tool of claim 24, wherein the power tool is a cordless power tool.

39. The power tool of claim 24, wherein the battery is one of the group consisting of a 12 volt battery, a 14.4 volt battery, and a 19.2 volt battery.

40. A cordless power tool comprising a battery, the power tool comprising:

(a) a battery receiving portion, integral with the power tool;

(b) an attachment portion, integral with the battery, that attaches to the battery portion; and

(c) a closure member for securing the attachment portion to the battery receiving portion, the closure member having a push button on a first end and an opposing second end, wherein depressing the push button inward relative to the battery receiving portion permits the attachment portion to be released from the battery receiving portion,

wherein the battery receiving portion has at least one guide channel and the attachment portion has at least one guide rail, wherein the at least one guide channel in the battery receiving portion interlocks with the at least one guide rail on the attachment portion.

41. The power tool of claim 40, wherein when the push button is not depressed, the second end of the closure member does not protrude from the battery receiving portion.

42. The power tool of claim 40, wherein a locking finger is located proximate the second end of the closure member.

43. The power tool of claim 42, wherein the at least one guide rail has a chamfered leading edge to facilitate interlocking.

44. The power tool of claim 43, wherein the locking finger has a chamfered surface.

45. The power tool of claim 40, wherein the attachment portion enters in engagement with the battery receiving portion on a rear side of the power tool, the push button is located at a side of the power tool that is not the rear side of the power tool, and the closure member moves transversely with respect to the battery receiving portion.

46. The power tool of claim 40, wherein the first end of the closure member is wider than the second end of the closure member.

47. The power tool of claim 40, wherein the closure member is a unitary body.

48. The power tool of claim 40, wherein the battery has an axis of major extension which is substantially parallel to an axis of major extension of a handle of the power tool.

49. The power tool of claim 40, wherein the power tool has an accessory.

50. The power tool of claim 49, wherein the accessory is a driver.

51. The power tool of claim 50, wherein the accessory is a drill bit.

52. The power tool of claim 40, wherein the battery is a rechargeable battery.

53. The power tool of claim 40, wherein the power tool is a cordless power tool.

54. The power tool of claim 40, wherein the battery is one of the group consisting of a 12 volt battery, a 14.4 volt battery, and a 19.2 volt battery.

55. The power tool of claim 40, wherein the power tool is one of the group consisting of a cordless reciprocating saw and a cordless circular saw.

56. The power tool of claim 40, wherein the at least one guide channel is generally L-shaped.

57. The power tool of claim 44, wherein the chamfered leading edge of the at least one guide rail is substantially coplanar with the chamfered surface of the locking finger.

* * * * *

EXHIBIT D

US005189570A

United States Patent [19]

Maeda et al.

[11] Patent Number: 5,189,570

[45] Date of Patent: Feb. 23, 1993

[54] BISTABLE MAGNETIC HEAD ADVANCING/RETRACTING DEVICE FOR ROTATING MAGNETIC RECORDING MEDIUM

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[73] Assignee: Fuji Photo Film Co, Ltd., Kanagawa, Japan

[21] Appl. No.: 746,186

[22] Filed: Aug. 15, 1991

Related U.S. Application Data

[63] Continuation of Ser. No. 314,112, Feb. 23, 1989, abandoned.

[30] Foreign Application Priority Data

Feb. 23, 1988 [JP] Japan 63-38700

[51] Int. Cl.[5] G11B 5/54

[52] U.S. Cl. 360/75; 360/105

[58] Field of Search 360/69, 75, 78.04, 103, 360/105, 106

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Primary Examiner—Jerry Smith
Assistant Examiner—Steven R. Garland
Attorney, Agent, or Firm—Birch, Stewart, Kolasch & Birch

[57] ABSTRACT

A magnetic head advancing apparatus which advances a magnetic head to be brought into contact with a magnetic recording medium (head loading) in response to a latch-type solenoid when a power supply switch is closed. The magnetic head is separated from the magnetic recording medium (head unloading) in response to a latch-type solenoid when the power supply switch is opened, when the power supply voltage drops below a predetermined level, or when the power supply (a battery) is ejected from the apparatus. This makes it possible to prevent local permanent deformation of a magnetic disk caused by prolonged abutting contact between the magnetic head and the magnetic disk.

14 Claims, 8 Drawing Sheets

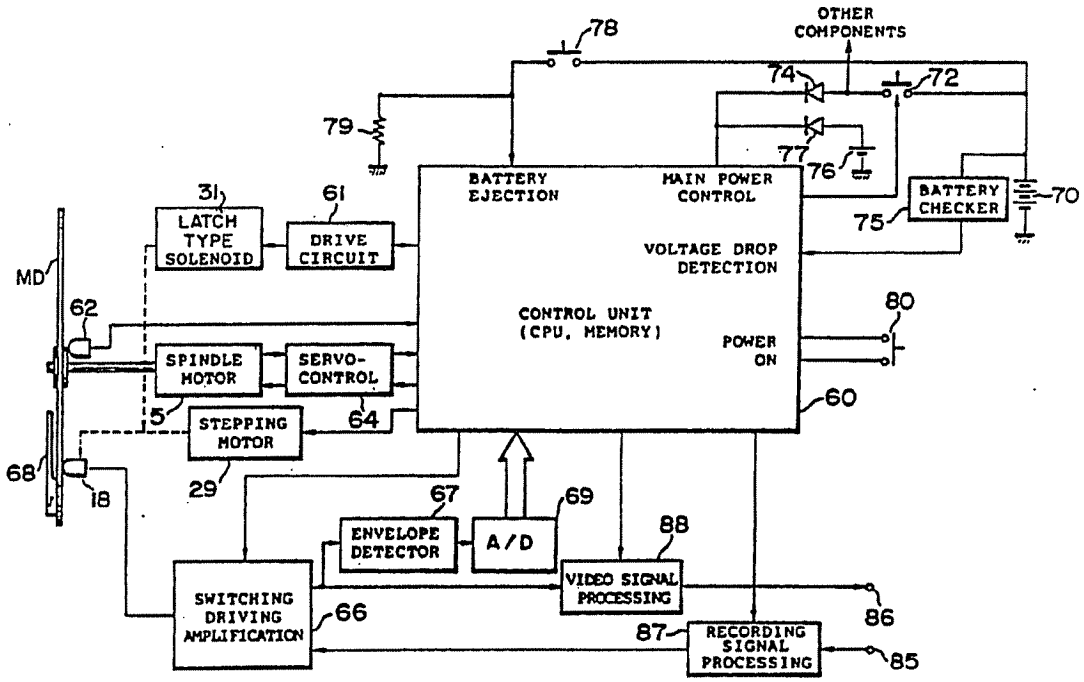
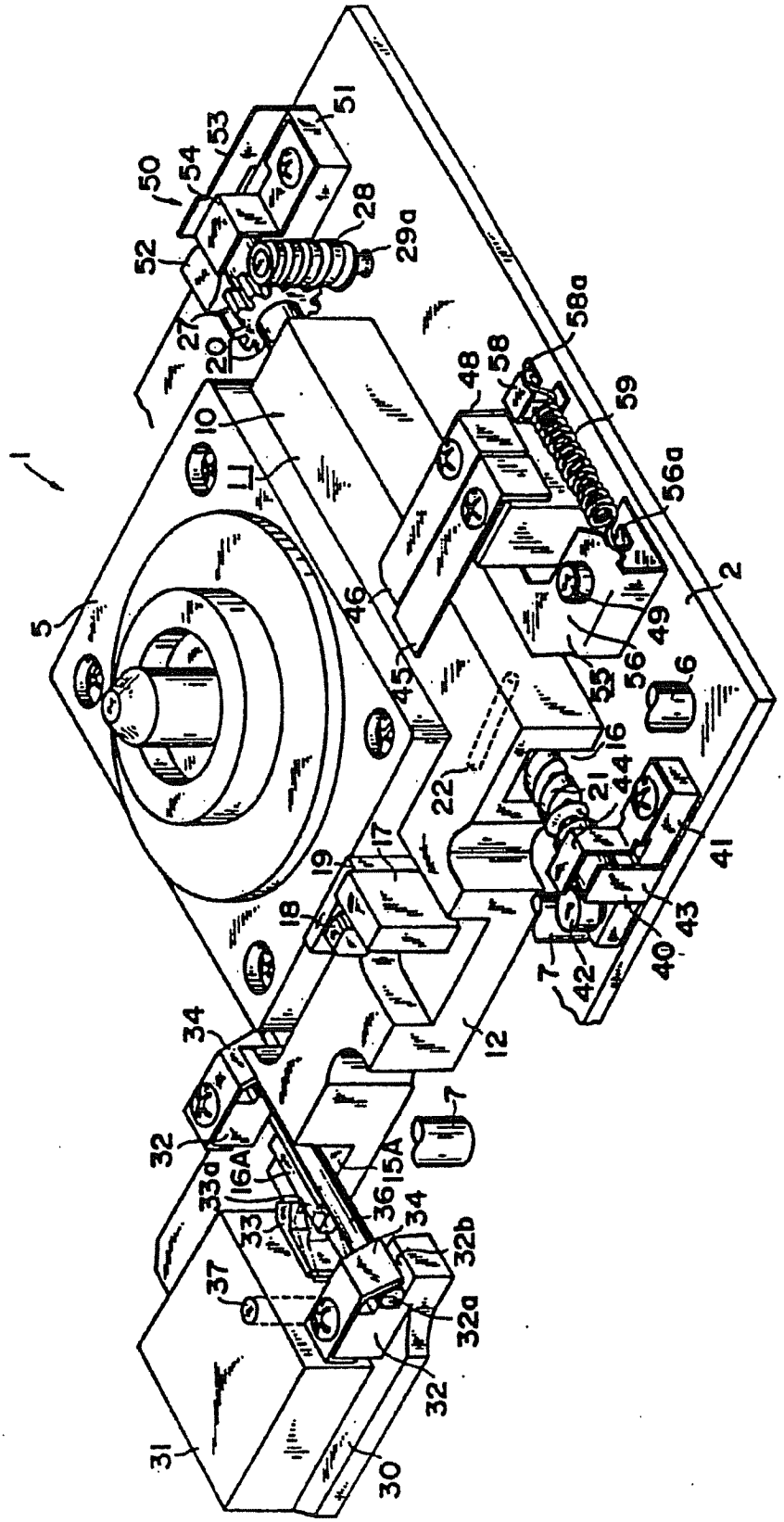


Fig. 1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16A
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29a
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31
32
32a
32b
33
33a
34
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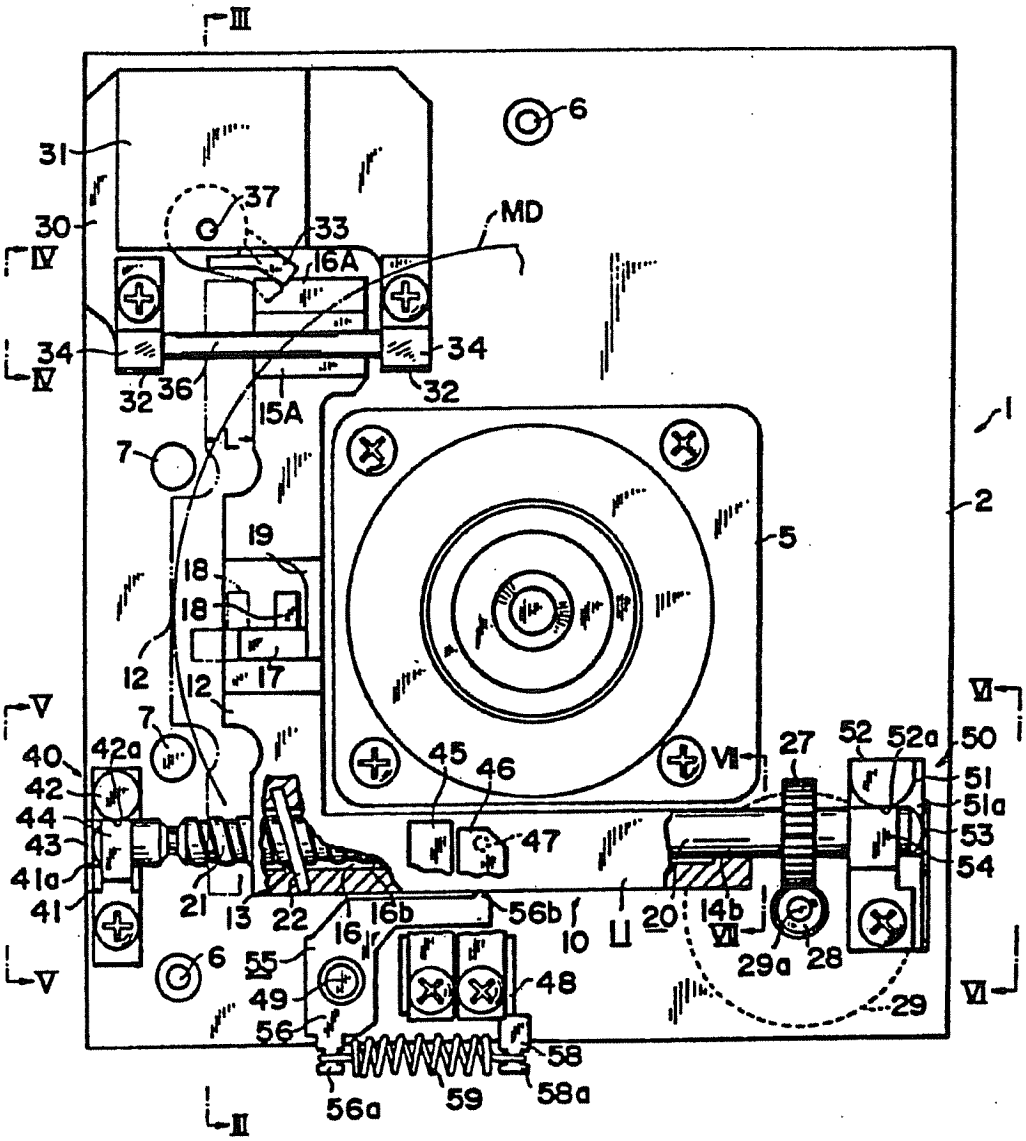
56a
58
58a
59

Fig.2


III
6
31
37
MD
30
33
IV
16A
34
34
IV
32
36
32
15A
I
7
2
19
5
18
18
12
17
12
V
7
VI
40
42a
45
46
27
52
52a
50
42
51
44
51a
43
47
53
41a
54
41
21
13
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16b
56b
10
LI
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58a
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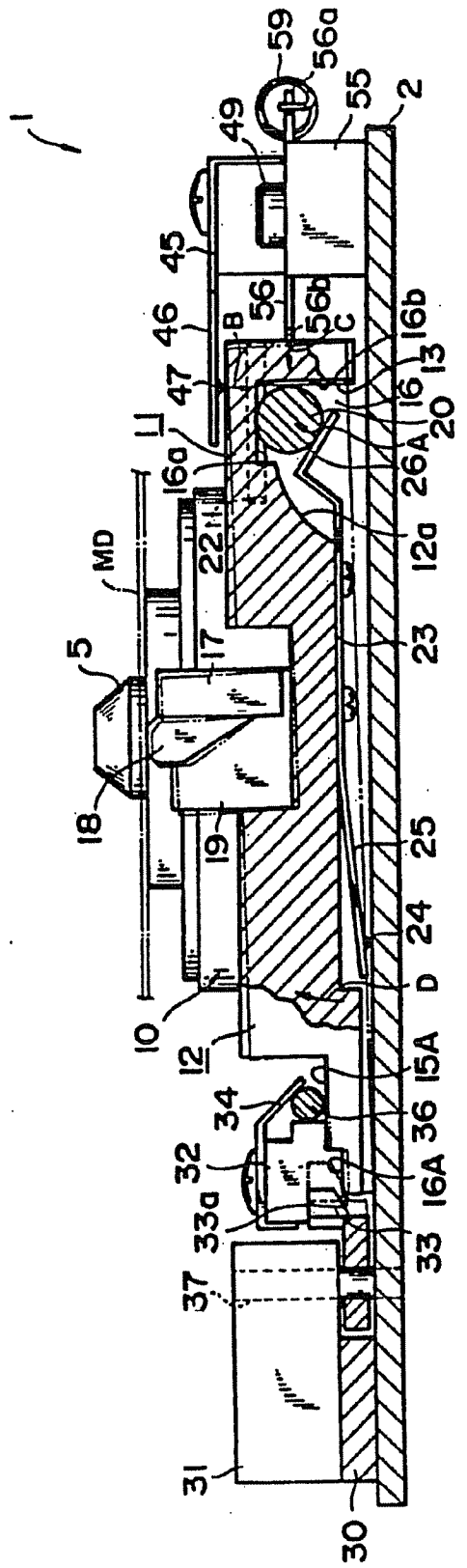
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22
12a
MD
17
23
5
18
19
25
24
D
10
12
15A
34
36
32
16A
33a
33
37
31
30

Fig.3

Fig.5

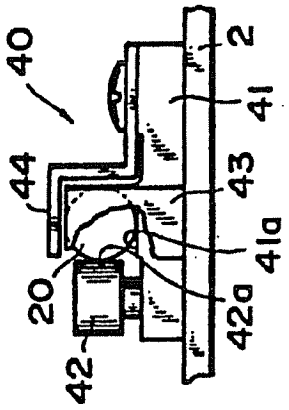


Fig.4

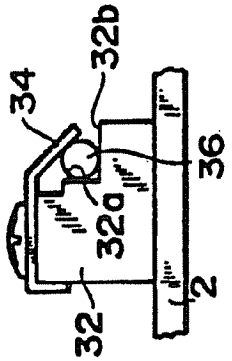


Fig.7

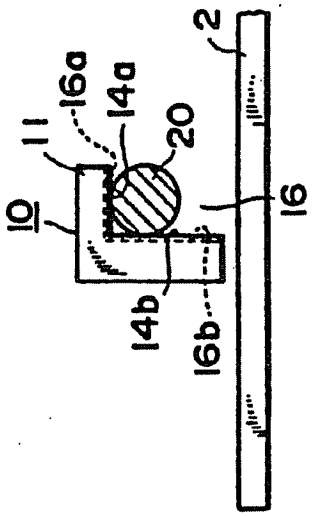
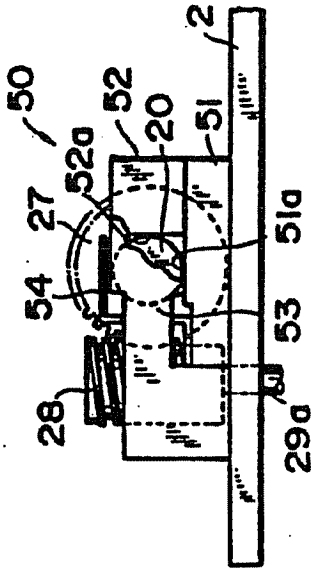


Fig.6



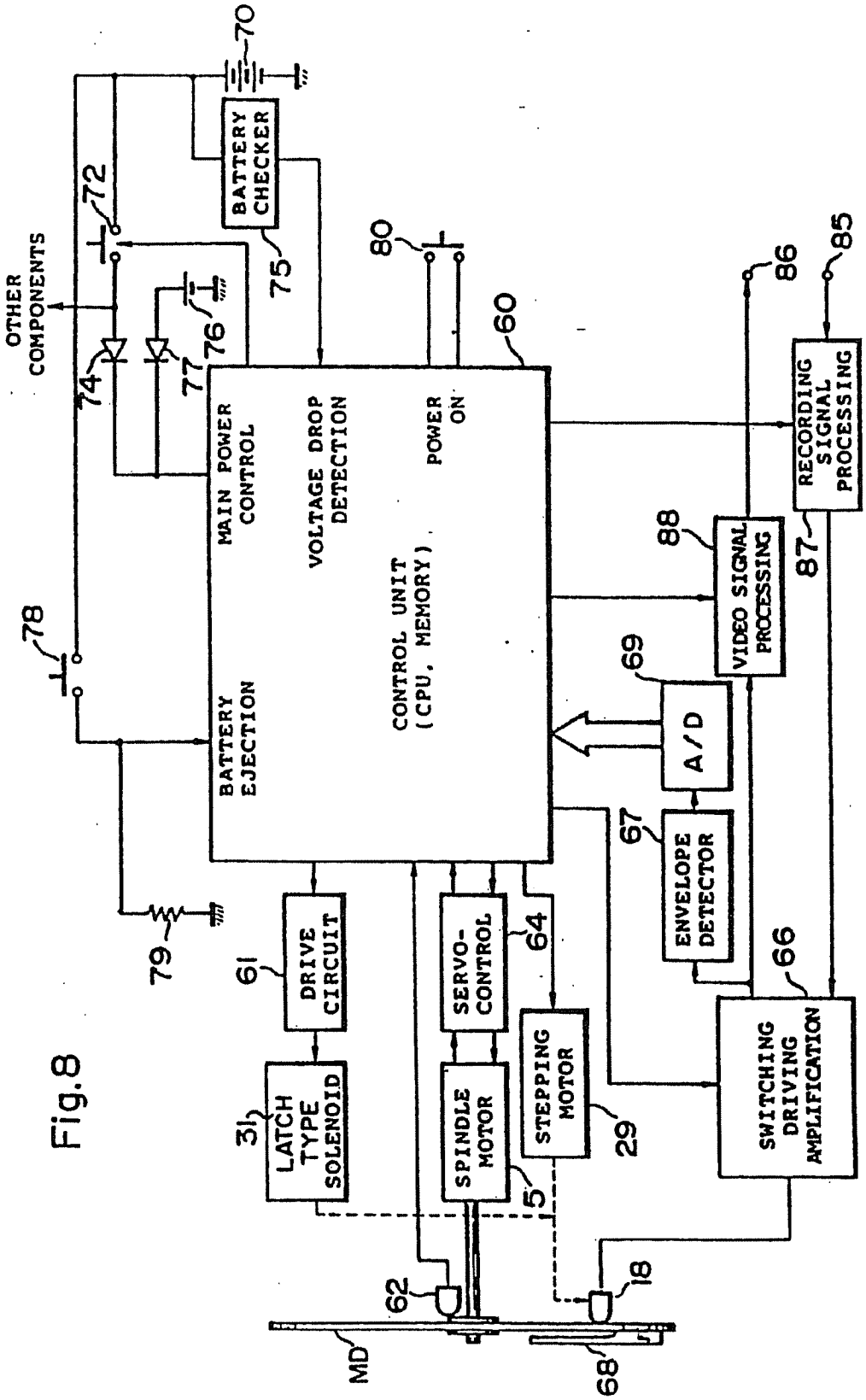

70
BATTERY CHECKER
72
75
80
86
85
OTHER COMPONENTS
74
76
77
60
MAIN POWER CONTROL
VOLTAGE DROP DETECTION
POWER ON
CONTROL UNIT (CPU, MEMORY)
BATTERY EJECTION
RECORDING SIGNAL PROCESSING
88
VIDEO SIGNAL PROCESSING
87
78
69
A/D
67
ENVELOPE DETECTOR
66
79
61
DRIVE CIRCUIT
64
SERVO-CONTROL
STEPPING MOTOR
29
SWITCHING DRIVING AMPLIFICATION
31
LATCH TYPE SOLENOID
SPINDLE MOTOR
5
62
18
MD
68

Fig.8

Fig.9

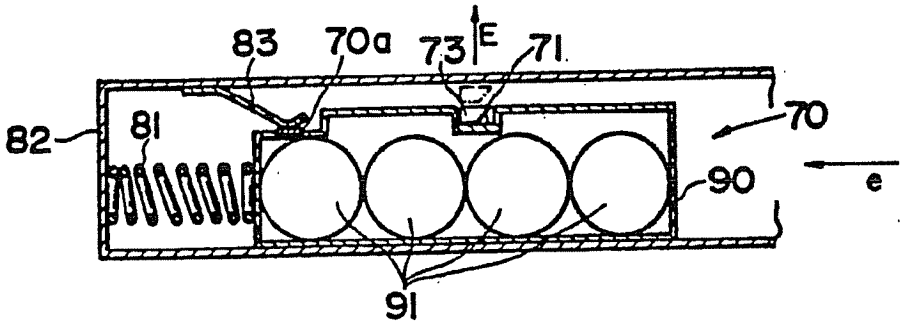


Fig.10

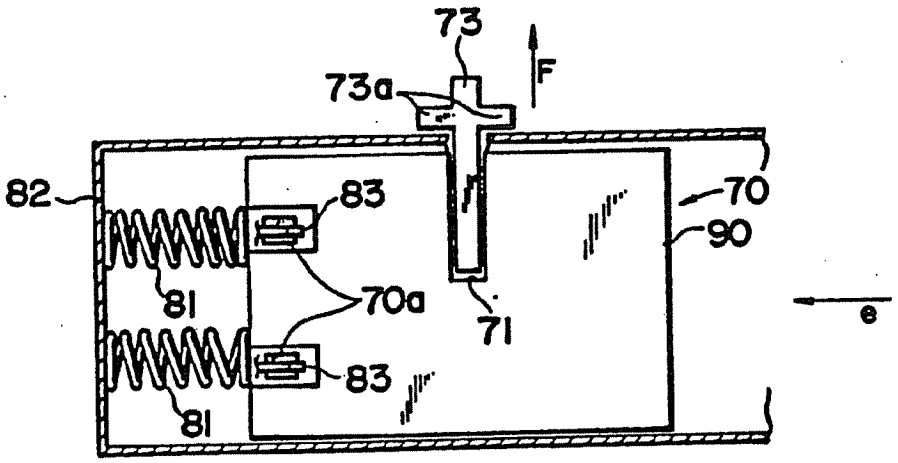


Fig.11a

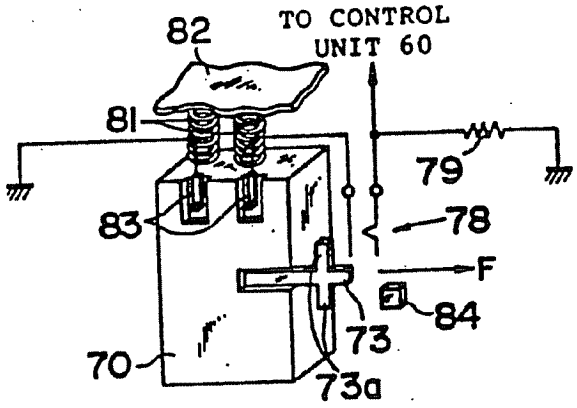


Fig.11b

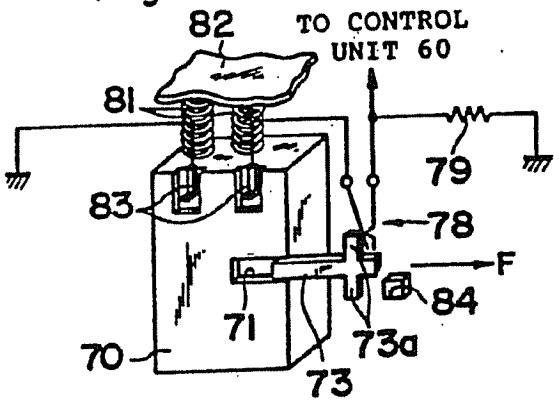


Fig.11c

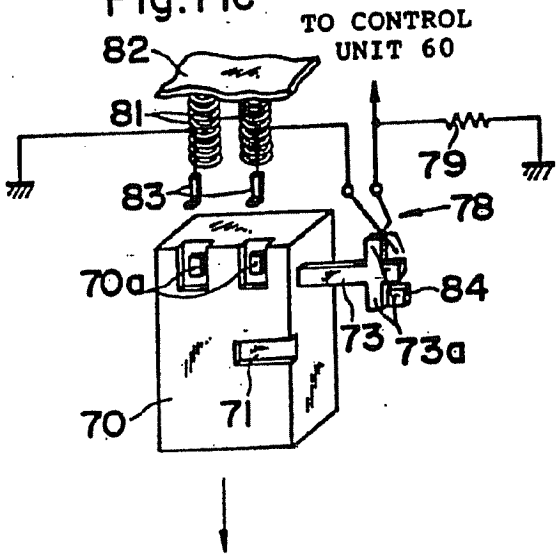


Fig.12

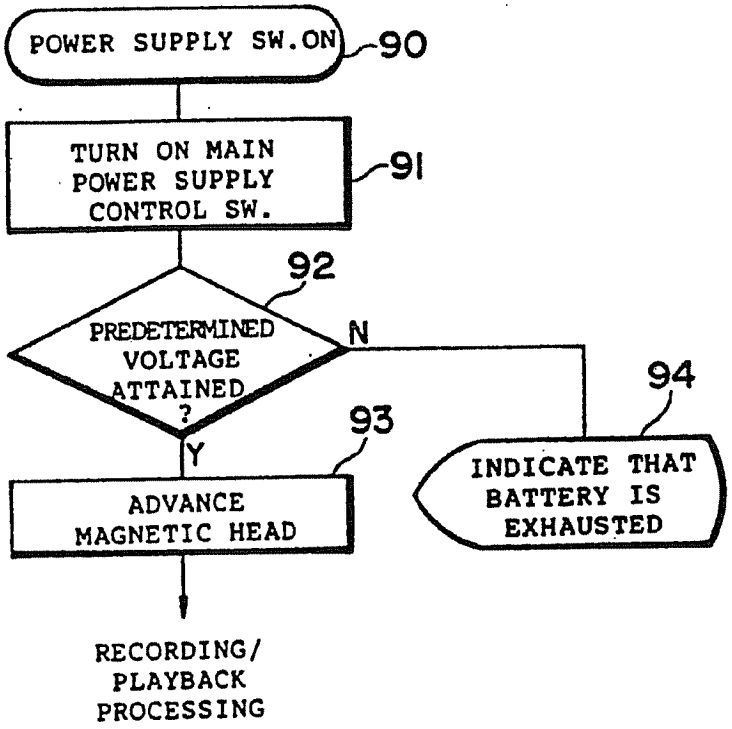
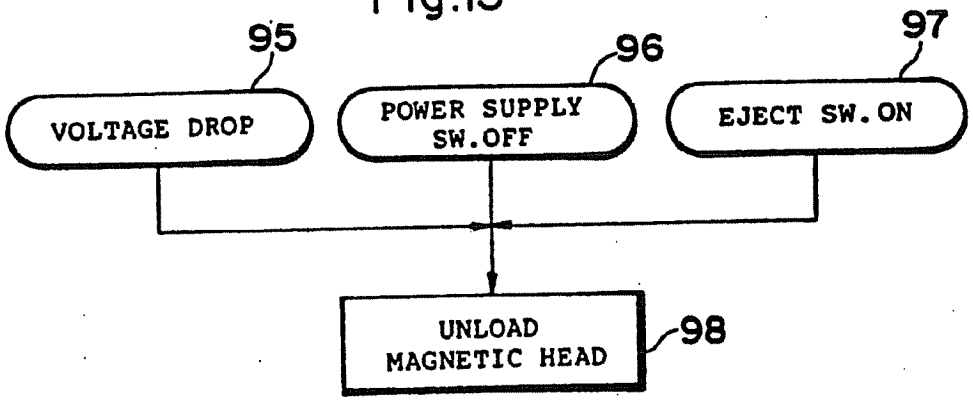

POWER SUPPLY SW.ON
90
TURN ON MAIN POWER SUPPLY CONTROL SW.
91
92
PREDETERMINED VOLTAGE ATTAINED ?
N
Y
93
94
ADVANCE MAGNETIC HEAD
INDICATE THAT BATTERY IS EXHAUSTED
RECORDING/ PLAYBACK PROCESSING

Fig.13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96
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VOLTAGE DROP
POWER SUPPLY SW.OFF
EJECT SW.ON
UNLOAD MAGNETIC HEAD
98

BISTABLE MAGNETIC HEAD ADVANCING/RETRACTING DEVICE FOR ROTATING MAGNETIC RECORDING MEDIUM

This application is a continuation, of application Ser. No. 07/314,112 filed on Feb. 23, 1989, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a magnetic recording/playback apparatus for a rotating magnetic recording medium (hereinafter referred to as a magnetic disk) capable of advancing a magnetic head in a direction to contact the magnetic disk in order to write a signal on any desired track or read a recorded signal from any desired track, and of retracting the magnetic head in a direction away from the magnetic disk.

2. Description of the Background Art

Electronic still camera systems have recently been developed. These systems combine an imaging device such as a solid state imaging element or image pickup tube with a recorder that employs an inexpensive magnetic disk of comparatively large storage capacity as a storage medium. The systems operate by electronically imaging a subject, recording a still picture of the subject on the magnetic disk and reproducing the recorded picture by a separately provided television system or printer. A video magnetic recording system has also been realized in which a still picture recorded on a visible recording medium such as ordinary film or photographic paper is imaged and recorded on a magnetic disk.

In systems of this kind, a video signal is recorded on the magnetic disk or read from the magnetic disk not by merely contacting the magnetic recording/playback head with the recording surface of the disk lightly but by pressing the head against the disk surface so strongly that the disk is partially deformed. Since the magnetic disk has some flexibility and therefore returns to its original state even when somewhat deformed, no problems are encountered even though the magnetic head is pressed against the rotating magnetic disk during recording or playback. However, when rotation of the magnetic disk is halted and the magnetic head is held in abutting contact with one location on the stationary magnetic disk, the portion of the disk in contact with the magnetic head becomes permanently deformed and is scarred or left with an impression of the head if such contact is allowed to continue for an extended period of time (e.g. for several hours to several days).

In an effort to solve this problem, devices of various types have been proposed for loading and unloading the magnetic head, namely for moving the magnetic head in a direction orthogonal to the surface of the disk to bring the head into contact with the disk (loading), and for moving the head away from the disk (unloading). Many of these loading/unloading devices are designed to repeat the loading/unloading of the magnetic head quite frequently, namely whenever a signal is recorded on or played back from a magnetic disk, whenever rotation of the magnetic disk starts, or whenever the magnetic head is transferred from one track to the next. Consequently, it is required that the loading/unloading device have a great amount of durability. Another problem that results is the occurrence of malfunction as due to wear, which develops comparatively quickly.

SUMMARY OF THE INVENTION

An object of the invention is to provide a magnetic disk magnetic recording/playback apparatus which makes it possible to prevent a magnetic disk from being left with the impression of a magnetic head, and in which there are almost no ill effects brought about by frequent loading/unloading of the magnetic head.

According to the present invention, the foregoing object is attained by providing a magnetic recording/playback apparatus for a magnetic disk, comprising a bistable magnetic head advancing/retracting device responsive to supply of driving power for advancing a magnetic head in a direction to contact a rotating magnetic disk and retracting the magnetic head in a direction away from the magnetic disk, and for stably holding the magnetic head at an advanced position or retracted position in the absence of a supply of driving power. Further includes is a means for detecting a state in which power having enough voltage to drive the magnetic head advancing/retracting device is capable of being supplied, and for detecting a state in which the supplied power is capable of being cut off, and means responsive to detection performed by the detecting means for executing control in such a manner that the magnetic head is advanced when the state is attained in which power is capable of being supplied for driving the magnetic head advancing/retracting device, and is retracted when the state is attained in which the supplied power is capable of being cut off.

The types of magnetic recording/playback apparatus to which the invention can be applied include an apparatus for magnetically recording a predetermined signal on a magnetic disk, an apparatus for reading and playing back a signal from a magnetic disk, and an apparatus having the dual functions of recording and playback.

The state in which power having enough voltage to drive the magnetic head advancing/retracting device is capable of being supplied is attained when battery output voltage is above a predetermined voltage and, moreover, a power supply switch is turned on. At such time the magnetic head is advanced to contact the magnetic disk. In other words, a state is attained in which recording/playback is possible.

The state in which the power supply is capable of being cut off is attained when the power supply switch is turned off, when the battery is expended and its output voltage drops below a predetermined voltage, when the battery is removed from the apparatus, etc. In cases such as these, the magnetic head is retracted.

Permanent deformation of a magnetic disk by a magnetic head occurs when the head remains in abutting contact with one point on the disk for an extended period of time with the disk at rest. This is likely to occur when a state is attained in which the power supply can be cut off, such as when the recording/playback apparatus is left with the power supply switch turned off. According to the invention, the magnetic head is retracted and parted from the magnetic disk upon attainment of the state in which the power supply is capable of being cut off. As a result, permanent deformation of the disk by the head does not occur. Since the magnetic head advancing/retracting device holds the retracted head stably at a retracted position without the passage of current, the magnetic head resides at the retracted position even when the supply of power is cut off.

When the state is attained in which power can be supplied, namely when there is a possibility of performing recording/playback, the magnetic head is loaded to contact the magnetic disc. As a result, a state is attained in which recording/playback becomes possible.

Since the loading/unloading of the magnetic head is performed only a number of times approximately equivalent to the number of times the power supply is turned on and off, the magnetic head advancing/retracting device is not driven frequently. The result is higher reliability.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus, are not limitative of the present invention, and wherein:

FIG. **1** is a perspective view illustrating the general features of a recording/playback section of a magnetic recording/playback apparatus;

FIG. **2** is a plan view of the recording/playback section;

FIG. **3** is a sectional view taken along line III—III of FIG. **2**;

FIG. **4** is a view as seen from line IV—IV of FIG. **2**;

FIG. **5** is a view as seen from line V—V of FIG. **2**;

FIG. **6** is a view as seen from line VI—VI of FIG. **2**;

FIG. **7** is a sectional view taken along line VII—VII of FIG. **2**;

FIG. **8** is a circuit diagram illustrating the electrical construction of a magnetic recording/playback apparatus;

FIGS. **9** and **10** illustrate a main battery in a loaded state, in which FIG. **9** is a sectional view and FIG. **10** a plan view;

FIGS. **11***a* through **11***c* are circuit diagrams illustrating an example of a battery ejection sensing switch;

FIG. **12** is a flowchart illustrating a processing procedure for advancing a magnetic head; and

FIG. **13** is a flowchart illustrating a processing procedure for retracting the magnetic head.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will now be described with reference to the drawings.

FIG. **1** is a perspective view illustrating the general features of a recording/playback section of a magnetic recording/playback apparatus, FIG. **2** is a plan view of the recording/playback section, FIG. **3** is a sectional view taken along line III—III of FIG. **2**, FIG. **4** is a view as seen from line IV—IV of FIG. **2**, FIG. **5** is a view as seen from line V—V of FIG. **2**, FIG. **6** is a view as seen from line VI—VI of FIG. **2**, and FIG. **7** is a sectional view taken along line VII—VII of FIG. **2**.

A magnetic disk MD is provided with a plurality (e.g. 50) of circular, concentrically disposed tracks. A guard band is provided between mutually adjacent tracks. By way of example, track width is 60 μm, guard band width 40 μm and track pitch 100 μm.

The 50 tracks of the magnetic disk MD are assigned consecutive track numbers No. 1 to No. 50 starting from the outermost track. A home position HP is situated on the outer side of the No. 1 track, and an end position EP is situated on the inner side of the No. 50 track.

As shown in FIGS. **1**, **2** and **3**, a recording/playback section **1** is assembled on a base plate **2**. Mounted substantially at the center of the base plate **2** is a spindle motor **5** for chucking and rotating the magnetic disk MD. Two pins **6** and two pins **7** are erected on the base plate **2**. The pins **6** are for positioning a floppy case within which the magnetic disk MD is retained in freely rotatable fashion. The floppy case is positioned by inserting the pins **6** into positioning holes located in the case. The pins **7** are for positioning a limiting plate holder (not shown) to which there is fixed a limiting plate **68**, described below, opposing a magnetic head **18** from the opposite side of the magnetic disk MD.

A lead screw **20** having a threaded portion **21** formed on one end portion thereof is so provided on the base plate **2** as to be horizontal and freely rotatable. The lead screw **20** is freely rotatably supported at both its ends by bearings **40**, **50**. The bearing **40** is equipped with a bearing pad **41** having a flat horizontal bearing surface **41***a* and fixed to the base plate **2**, and a bearing column **42** having a vertical bearing surface **42***a* which is circular (see FIG. **5**). The bearing **50** is equipped with a bearing pad **51** having a flat horizontal bearing surface **51***a* and fixed to the base plate **2**, and a bearing column **52** having a vertical bearing surface **52***a* which is semi-circular (see FIG. **6**). As will be set forth in detail hereinbelow, both end portions of the lead screw **20**, having circular circumferential surfaces, are brought into pressured contact with the horizontal bearing surfaces **41***a*, **51***a* and vertical bearing surfaces **42***a*, **52***a* of the bearings **40**, **50** by spring force. These end portions are received in a freely rotatable manner owing to linear contact with the bearing surfaces **41***a*, **51***a*, **42***a*, **52***a*. A stopper **43** is attached to the bearing **40**, and a leaf spring **53** is attached to the bearing **50**. The lead screw **20** is prevented from moving longitudinally by abutting the leaf spring **53** against a hemispherically formed end face of the lead screw **20** while the other end face of the lead screw is urged against the stopper **43**. The bearings **40**, **50** are provided with respective stoppers **44**, **54**, which prevent the lead screw **20** from falling out. These stoppers have portions which extend over the lead screw **20** to perform this function. A small gap is provided between the lead screw **20** and each of the stoppers **44**, **54**.

A worm gear **27** is secured to the lead screw **20** on the side thereof opposite the threaded portion **21**. The worm gear **27** meshes with a worm **28** fixed to an output shaft **29***a* of a stepping motor **29** (indicated by the dashed line in FIG. **2**). The stepping motor **29** is secured to the underside of the base plate **2**, with its output shaft **29***a* being passed loosely through a hole in the base plate **2** so as to project from its top side. The lead screw **20** is rotated by driving the stepping motor **29**.

A head carriage **10** is composed of an integrally formed sliding portion **11** and head mounting portion **12**. These portions are joined to each other at one end thereof so as to form an L-shaped configuration when viewed from a plane.

The sliding portion **11** is formed to have a recess **16** longitudinally thereof for receiving the lead screw **20**

passed therethough. The recess **16** on the side of a spindle **5** is open except for the end of the sliding portion **11** to which the head mounting portion **12** is joined. Naturally, the lower side of the recess **16** is open along its entire length. The recess **16** has a downwardly directed horizontal surface **16***a* and an inwardly directed vertical surface **16***b*. One end of the sliding portion **11** situated on the side of the worm gear **27** is formed to include portions projecting somewhat beyond the two surfaces **16***a*, **16***b* of the recess **16**. These projecting portions have a flat horizontal sliding surface **14***a* and a flat vertical sliding surface **14***b* which intersect each other at right angles (see FIG. **7**). The sliding surfaces **14***a*, **14***b* are so disposed as to oppose the bearing surfaces **51***a*,**52***a* of the bearing **50** (and the surfaces **41***a*, **42***a* of bearing **40**).

A needle **22** which engages with the thread bottom of the threaded portion **21** of lead screw **20** is embedded in the other end of the sliding portion **11**, namely the end joined to the head mounting portion **12**. The needle **22** crosses the upper portion of the recess **16** obliquely and lies substantially parallel to the horizontal surface **16***a* of the recess **16**. The vertical surface **16***b* of the recess **16** is provided with a protruding sliding portion **13** abutting against the threads of the threaded portion **21** of lead screw **20**. This protruding sliding portion **13** extends in the vertical direction. Though it is preferred that the protruding sliding portion **13** be situated at a thread adjacent the thread bottom of the threaded portion **21** engaged by the needle **22**, it is not always necessary to be adjacent. As will be described below, the head carriage **10** and lead screw **20** are biased by springs in such a manner that the sliding surfaces **14***a*, **14***b* abut against the peripheral surface of the one end of lead screw **20** devoid of the threaded portion **21** and the needle **22** and protruding sliding portion **13** abut against the thread bottom and thread, respectively, of the threaded portion **21** at the other end of the lead screw **20**.

The head carriage **10** is formed to include a recess near the middle of the head mounting portion **12**, the recess being provided with an upwardly projecting mounting piece **19**. A magnetic head **18** is fixed to the mounting piece **19** via a mounting member **17**. (Two magnetic heads **18** are provided in an arrangement in which frame recording is possible.)

The end of the head mounting portion **12** opposite its joint with the sliding portion **11** is provided with steps formed to have horizontal surfaces **15A** and **16A**. The horizontal surface **16A** is formed at the tip of the head mounting portion **12**. A rod **36** both ends of which are supported by pads **32** integrally molded with a seat **30** extends across the horizontal surface **15A**. The seat **30** is secured to the base plate **2**. The pad **32** is formed to have a vertical surface **32***a* and a horizontal surface **32***b* which intersect each other at right angles (see FIG. **4**). The rod **36** is fixed by being urged by a leaf spring **34**, which is attached to the pad **32**, so as to abut against the surfaces **32***a*, **32***b*. As will be set forth below, the abovementioned end of the head mounting portion **12** is biased upwardly by the force of a leaf spring **23** so that the horizontal surface **15A** is in abutting contact with the rod **36**.

A latch-type solenoid **31** is secured to the seat **30**. The solenoid **31** has an output shaft **37** which, by way of example, is rotated through $+10°$ by positive pulses and through $-10°$ by negative pulses. Fixed to the output shaft **37** is an oscillating member **33** the tip whereof is provided with an upwardly projecting portion. The lower surface of this projecting portion is formed to have a slanted face **33***a* for engaging the horizontal surface **16A** of the head carriage **10** at an operating position (see FIG. **3**). The latch-type solenoid **31** is advantageous in that power consumption can be reduced since drive is possible with a pulsed current. By driving the latch-type solenoid **31**, the oscillating member **33** is made to assume an operating position, which is indicated by the phantom lines, or a stop position, which is indicated by the solid lines. In the operating and stop positions, the latch-type solenoid **31** is held in stable fashion even without being energized. In other words, it will suffice to pass a current through the solenoid only when the oscillating member **33** is shifted between the operating position and the stop position.

As shown in FIG. **3**, the bottom side of the head mounting portion **12** is formed to include a recess to which the leaf spring **23** is secured at its central portion. One end **26** of the leaf spring **23** is bent into a generally L-shaped configuration to abut against the threaded portion **21** of the lead screw **20** diagonally from below. A force acts to urge the lead screw **20** obliquely and upwardly, as indicated by the arrow A. The lower surface at the tip of the other end **25** of the leaf spring **23** is provided with a projection **24** which abuts against the base plate **2**. As a result, a force acts to urge upwardly the end of the head mounting portion **12** provided with the horizontal surface **15A**, as indicated by the arrow D in FIG. **3**. This causes the horizontal surface **15A** to abut against the rod **36**. The lower surface of the head mounting portion **11** of head carriage **10** is formed to have a cut-out **12***a* leading to the recess **16**. This assures that the end **26** of leaf spring **23** will function.

Another leaf spring **46** is attached at one end to a mounting base **48** provided on the base plate **2**. A protrusion **47** is provided on the underside of the leaf spring **46** at its other end. The protrusion **47** abuts against the upper surface of the sliding portion **11** of head carriage **10** substantially at its mid-section in the longitudinal direction. The position at which the protrusion **47** contacts the sliding portion **11** is somewhat outward of a point exactly above the lead screw **20**. As indicated by the arrow B in FIG. **3**, a perpendicular force acts upon the sliding portion **11** of the head carriage **10**. A stopper **45** is attached to the mounting base **48** at a position alongside the leaf spring **46**. A slight gap exists between the stopper **45** and the sliding portion **11**.

With reference to FIGS. **1** and **2**, a shaft **49** is erected on the base plate **2** adjacent the mounting base **48** on the base plate **2**. The shaft **49** is provided with an urging lever **55** that is free to oscillate in the horizontal direction. The lever **55** is formed to have an inverted U-shaped vertical cross section. The urging lever **55** has an upper surface piece **56** one end of which is extended horizontally along the side face of the sliding portion **11** of head carriage **10** up to a point near where the protrusion **47** of leaf spring **46** contacts the head carriage **10**. The tip of this extended end is formed to have a projection **56***b* projecting horizontally toward the sliding portion **11** of the head carriage **10** and contacting the side face of the sliding portion **11**. The positions at which the protrusion **47** of leaf spring **46** and the projection **56***b* of urging lever **55** contact the sliding portion **11** lie on the same straight line, which perpendicularly intersects the direction of movement of head carriage **10**. The other end portion of the upper surface piece **56** of urging lever **55** is formed to have a spring mounting portion **56***a*. On the other hand, a mounting member **58** formed to have

a spring mounting portion 58*a* is secured to the mounting base 48. A tension spring 59 is stretched between the mounting portions 56*a*, 58*a*. Accordingly, the urging lever 55 is biased by the spring 59 so that a horizontal force directed toward the lead screw 20 as indicated by arrow C in FIG. 3 acts upon the sliding portion 11 of head carriage 10.

Owing to the strong downwardly directed vertical force B due to the leaf spring 46 and the horizontal force C due to the urging lever 55, the sliding surfaces 14*a*, 14*b* of the sliding portion 11 of head carriage 10 abut against the lead screw 20, the protruding sliding portion 13 abuts against the threads of the threaded portion 21 and the lead screw 20 abuts against the horizontal bearing surfaces 41*a*, 51*a* and vertical bearing surfaces 42*a*, 52*a* of the bearings 40, 50 at both its ends. The needle 22 naturally engages with the thread bottom of the threaded portion 21 of lead screw 20. The force A due to the end portion 26 of leaf spring 23 urges the lead screw 20 against the sliding portion 11 in a direction substantially opposite that of the result force of forces B and C, thereby establishing reliable abutting contact between the lead screw 20 and the sliding portion 11.

When the lead screw 20 is rotated, the head carriage 10 is fed in the axial direction of the lead screw 20 since the needle 22 is engaged with the threaded portion 21. The guiding of the head carriage 10 is carried out in positive fashion by virtue of the abutting contact between the sliding surfaces 14*a*, 14*b* and the lead screw 20, the abutting contact between the protruding sliding portion 13 and the threads, and the abutting contact between the horizontal surface 15A and rod 36. It goes without saying that since the head carriage 10 is fed with rotation of the lead screw 20, the protruding sliding portion 13 abuts against the threads of the threaded portion 21 at all times. The range of reciprocating movement of the head carriage 10 is indicated at L in FIG. 2.

In an ordinary state in which a signal can be recorded ion the magnetic disk MD or played back form the magnetic disk MD by the magnetic head 10, the head carriage 10 is maintained in the horizontal condition by the force of leaf spring 23 and the magnetic head 18 is in intimate contact with the surface of the magnetic disk MD, as clearly shown in FIG. 3. This represents the head in the loaded state. At this time the oscillating member 33 of the latch-type solenoid 31 is standing by at the stop position, which is indicated by the solid line in FIG. 2.

When the latch-type solenoid 31 is energized, the oscillating member 33 is turned to assume the operating position shown by the phantom liens. As a result, the slanted face 33*a* of the oscillating member 33 and the edge of the horizontal surface 16A of head carriage 10 come into contact (see FIG. 3), so that the oscillating member 33 urges this edge portion of the head carriage 10 downward. Consequently, the head carriage 10 is turned slightly about the lead screw 20, as shown by the phantom lines in FIG. 3, so that the head carriage 10 assumes a tilted attitude and separates the magnetic head 18 from the magnetic disk MD. In other words, the head is unloaded. The magnetic head 18 is thus retracted.

This operation to retract the magnetic head from the magnetic disk MD is possible when the head carriage 10 is at any position within the range L of reciprocating movement. When the stop position indicated by the solid lines prevails, the oscillating member 33 of the solenoid 31 will not act upon the edge of the horizontal surface 16A regardless of the position of head carriage 10.

When the latch-type solenoid 31 is rotated in the reverse direction to return the oscillating member 33 to the stop position, the head carriage 10, under the biasing forces of the leaf springs 23, 46, is restored to an attitude in which the magnetic head 18 contacts the magnetic disk MD.

In the above-described embodiment, the head carriage 10 is formed to have the recess 16 into which the lead screw 20 is fitted. However, an alternative arrangement is possible wherein the head carriage 10 is provided with a guide portion having a through-hole through which the portion of the lead screw 20 other than threaded portion 21 is passed in a freely rotatable and freely slidable manner.

FIG. 8 illustrates the electrical construction of a magnetic recording/playback apparatus.

The operation of each of the components constituting the magnetic recording/playback apparatus, as well as the overall operation of the apparatus, is under the control of a control unit 60. The latter comprises a central processor, preferably a microprocessor (hereafter referred to as a "CPU"), a memory for storing a program run by the CPU and necessary data, and an interface for providing a connection to peripheral elements, circuits and devices.

A spindle motor 5 is subjected to feedback control by a servo-control circuit 64 so as to be rotated at a constant speed, e.g. 3,600 rpm. The servo-control circuit 64 is also adapted to start and stop the motor 5 in response to commands from the control unit 60. A phase detector 62 is provided so as to be close to the core of the magnetic disk MD. The phase detector 62 detects the magnetic flux of a permanent magnet for chucking, which flux leaks from a magnetic body (not shown) provided on the core of the magnetic disk MD, and generates a single pulse PG each time the magnetic disk MD makes one full revolution. The output pulses PG of the phase detector 62 are inputted to the control unit 60. Since the magnetic disk MD is rotated at a constant 3600 rpm in the illustrated embodiment, the magnetic head MD records on the disk, or plays back from the disk, a video signal corresponding to one track, namely a frequency-modulated video signal of one field, every revolution, i.e., every 1/60 of a second.

The magnetic head 18 is supported so as to be freely movable radially of the magnetic disk MD, and has its movement controlled in the same direction, by the head carriage 10 driven by the stepping motor 29, as set forth above. The control unit 60 instructs the stepping motor 29 with regard to the direction and amount of movement of the magnetic head 18.

Since video signal recording, etc., is carried out while the magnetic disk MD is rotating, the limiting plate 68 is provided in order to maintain proper contact between the magnetic head 18 and magnetic disk MD at all times.

The magnetic recording/playback apparatus is capable of inputting a signal and recording the signal on the magnetic disk MD (this is referred to as the recording mode). A video signal which enters at an input terminal 85 is subjected to frequency modulation and other processing by a recording signal processing circuit 87, after which the processed signal is applied to the magnetic head 18 via a circuit 66 for switching, drive and amplifi-

cation. If the magnetic recording/playback apparatus is an electronic still video camera, the video signal applied to the input terminal **85** is obtained by an imaging operation relying upon an imaging optical system that includes a solid-state electronic imaging element.

The magnetic recording/playback apparatus of this embodiment is capable also of playing back a video signal recorded on the magnetic disk MD. The switching, driving and amplifying circuit **66** is adapted to switch between the recording mode and a playback mode under the control of the control unit **60**.

In the playback mode, the playback output of the magnetic head **18** is amplified by the switching, driving and amplifying circuit **66** and then fed into a video signal processing circuit **88** and an envelope detector circuit **67**. The video signal processing circuit **88** subjects the video signal read by the magnetic head **18** to signal processing to produce a composite video color signal in e.g. an NSTC format. The color video signal outputted by the circuit **88** is applied to a color television system (not shown) having a cathode-ray tube display (CRT) and a CRT control circuit. A still picture produced by a video signal recorded on the magnetic disk MD appears visually on the screen of the CRT.

The envelope detector circuit **67** detects the envelope of the signal read by the magnetic head **18**, namely the envelope of the frequency-modulated video signal recorded on a track of the magnetic disk MD, and outputs a voltage signal conforming to the detected envelope. This voltage signal representing the envelope is fed into an analog/digital (A/D) converter **69**, which proceeds to convert the signal into an eight-bit digital signal representing a quantization level of e.g. 256. This signal enters the control unit **60**.

The envelope detection signal is used to search for unrecorded tracks on the magnetic disk MD and to detect the center positions of recorded tracks. Specifically, if the level of a detected signal does not attain a predetermined threshold level when the magnetic head **18** crosses a track, then that particular track has not been recorded on. In the recording mode, the recording of a video signal, which is obtained by photographing a subject, onto the magnetic disk MD is usually performed by recording the signal on an outermost unrecorded track searched for as described above (though there are exceptions). In the playback mode, the magnetic head **18** is fed incrementally over short distances radially of the magnetic disk MD, and a position at which the detected signal peaks is construed to be the center of a track on which a video signal has been recorded. The video signal is played back with the magnetic head **18** being positioned on the center of this track.

The latch-type solenoid **31** is driven by a drive circuit **61** under the control of the control unit **60**.

In addition to controlling the rotation of the magnetic disk MD and the recording/playback of video signals, the control unit **60** reads signals from various switches, controls camera operation based on the results of the read signals, and executes head loading and unloading processing, described below.

A main battery (main power supply) **70** is provided in order to supply the control unit **60** and other components constituting the magnetic recording/playback apparatus with operating power. The output voltage of the main battery is supplied to the various components through a main power supply control switch **72**, and to the control unit **60** through a diode **74**. Connected to the main battery **70** is a battery checker **75** for detecting that the output voltage of the main battery **70** has fallen below a predetermined voltage. When this has been detected, the battery checker **75** delivers a signal indicative of the fact to the control unit **60**. Also applied to the control unit **60** is a detection signal, which indicates ejection of the main battery **70**, that arrives from an ejection sensing switch **78** closed by ejecting the main battery **70** from the apparatus. The operation of switch **78** will be described in detail hereinbelow.

A power supply switch (e.g., a push-button switch) **80** is connected to the control unit **60**. In response to a switch-on signal from the power supply switch **80**, the control unit **60** controls the on/off operation of the main power supply control switch **72**.

An auxiliary battery (auxiliary power supply) **76** is provided in order to supply the control unit **60** with operating power when the main power supply control switch **72** is off. The output side of the auxiliary battery **76** is connected to the control unit **60** via a diode **77**. When the main power supply control switch **72** is off, the main control unit **60** is held in the stand-by state by the auxiliary battery **76**. When there is an input from the power supply switch **80**, the main control unit **60** is started and responds by closing the main power supply control switch **72**. When the power supply switch **80** is pressed again so that an input arrives from this switch, the control unit **60** opens the switch **72** and returns to the stand-by state.

FIGS. **9** and **10** illustrate the manner in which the main battery **70** is accommodated.

The main battery **70** comprises a case **90** and a plurality (four in this embodiment) of dry cells **91** accommodated within the case **90**. It is also permissible to use a main battery **70** of the type in which the dry cells **91** are not internally accommodated. Positive (+) and negative (−) terminals **70***a* are provided in exposed formed in respective recesses formed in the upper edge portion of the case **90**. A locking recess **71** extending from one side of the case **90** to its central portion is formed in the upper surface of the case substantially at the middle thereof.

The location of the magnetic recording/playback apparatus at which the main battery **70** is installed is provided with two counter springs **81** biasing the main battery **70**, which is received at a predetermined position, in an ejecting direction, terminals **83** contacting the terminals **70***a* of the main battery **70** received at the predetermined position, and a lock lever **73** fitted into the locking recess **71** for holding the main battery **70** at the predetermined position against the biasing forces of the counter springs **81**. The portion of the lock lever **73** that is inserted into the recess **71** of main battery **70** is tapered in shape to facilitate the insertion of the lock lever **73**. Protrusions **73***a* at the base portion of the lock lever **73** are for the purpose of actuating the ejection sensing switch **78**, as will be described below.

When the battery **70** is inserted into its loading location of the magnetic recording/playback apparatus in the direction of arrow e, the tapered surface of the lock lever **73** contacts the upper surface of the case **90**. As the battery **70** is inserted further, the lock lever **73** flexes in the direction of arrow E. As the battery **70** is inserted still further so as to overcome the biasing forces of the counter springs **81** secured to a base plate **82**, the lock lever **73** fits itself into the recess **71** to lock the battery **70** at this position.

When the battery 70 is removed from its loading location, the lock lever 73 is moved in the direction of arrow F to disengage the lock lever 73 from the recess 71. As a result, the battery 70 is thrust out by the biasing forces of the counter springs 81.

FIGS. 11*a* through 11*c* are circuit diagrams illustrating an example of the ejection sensing switch 78. FIG. 11*a* shows a state in which the main battery 70 is locked in place and the switch 78 is open, FIG. 11*b* a state in which the switch 78 is closed in the course of unlocking the battery 70, and FIG. 11*c* a state in which the main battery 70 is in the process of being ejected by completely unlocking the battery 70.

The ejection sensing switch 78 is composed of two contacts disposed in the vicinity of the protrusions 73*a* of the lock lever 73. When the main battery 70 is loaded and locked in its loading location of the magnetic recording/playback apparatus, as shown in FIG. 11*a*, the two contacts of the ejection sensing switch 78 are spaced away from each other; hence, the switch 78 is open. When the lock lever 73 is moved in the direction of arrow F in order to eject the main battery 70, as shown in FIG. 11*b*, the protrusion 73*a* of the lock lever 73 pushes one of the contacts constituting the ejection sensing switch 78, thereby closing the ejection sensing switch 78. With the ejection sensing switch 78 thus in the closed state, the main battery 70 is kept locked by the lock lever 73 and the terminals 83 are in contact with the terminals 70*a* of case 90. Accordingly, an ON signal indicating closure of the switch 78 is delivered from this switch to the control unit 60, whereby ejection of the main battery 70 is sensed. At disengagement (unlocking) of the main battery 70, the battery is thrust out of the apparatus by the biasing forces of the counter springs 81. At this time, the ejection sensing switch 78 remains closed. However, since the terminals 83 are separate from the terminals 70*a* of the case 90, the signal inputted to the control unit 60 turns off without the voltage of main battery 70 being supplied to the switch 78.

A stopper 84 is provided in the vicinity of the ejection sensing switch 78. When the protrusion 73*a* of the lock lever 73 abuts against the stopper 84, this limits the movement of the lock lever 73.

FIG. 12 is a flowchart illustrating the processing procedure for advancing the magnetic head 18 toward the magnetic disk MD (head loading).

When the power supply switch 80 of the magnetic recording/playback apparatus is closed at step 90, the main power supply control switch 72 is closed by the control unit 60 at step 91. The control unit 60 then changes over from the stand-by state to the started state. When the voltage of the power supply 70 is above a predetermined voltage and a drop in the battery voltage is not detected by the battery checker 75 (YES at step 92), the latch-type solenoid 31 is driven by the control unit 60 via the drive circuit 61. As a result, the oscillating member 33 is turned through a predetermined angle in the reverse direction and is thereby shifted to the stop position. The head carriage 10 is moved by the force of spring 23 in a direction which will move the magnetic head 18 to the magnetic disk MD (head loading) at step 93. If the output voltage of the main battery 70 is less than the predetermined voltage, a drop in voltage is detected by the battery checker 75. Thus, a NO answer is received at step 92 even if the power supply switch 80 is closed. This means that head loading is not carried out. Instead, an indication is given at step 94 that the battery has run out.

FIG. 13 is a flowchart illustrating the processing procedure for retracting the magnetic head 18 from the magnetic disk MD (head unloading).

When the main power supply control switch 72 is closed and the control unit 60 has been started, a drop in voltage is detected by the battery checker 75 at step 95. When the power supply switch 80 is pressed opening of the main power supply switch 72 is detected at step 96. When the battery 70 is ejected, the ejection detection signal is outputted and detected at step 97 by the ejection sensing switch 78, as described above. When any one of the operations of steps 95, 96, 97 is performed, the latch-type solenoid 31 is driven by the control unit 60 via the driver circuit 61. As a result, the oscillating member 33 fixed to the output shaft 37 is shifted to the operating position by being rotated through a predetermined angle (e.g., +10° by positive pulses). The head carriage 10 moves against the force of the spring 23 in a direction which will separate the magnetic head 18 from the magnetic disk MD (head unloading) at step 98.

The opening of the main power supply switch at step 96 includes a case in which the power supply is turned off automatically when the magnetic recording/playback apparatus is not operated over a predetermined period of time (as when keys on the apparatus are not pressed over a predetermined period of time). The head carriage 10 moves in a direction which will separate the magnetic head 18 from the magnetic disk MD, in the manner described above, when power is turned off automatically as just set forth.

As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

What is claimed is:

1. A magnetic recording/playback apparatus for a rotating magnetic recording medium, comprising:

bistable magnetic head advancing/retracting means, responsive to supply of driving power, for advancing a magnetic head to an engaged position in contact with the rotating magnetic recording medium and for retracting said magnetic head to a disengaged position away from the rotating magnetic recording medium, and for stably holding said magnetic head at said engaged position or said disengaged position in the absence of supply of said driving power, said bistable magnetic head advancing/retracting means comprising

engagement means, positionable to be urged down upon a horizontal surface of a head carriage of said magnetic head, for retracting said magnetic head to a disengaged position from said rotating magnetic recording medium, and

a latch-type solenoid, responsive to supply of said driving power, for stably holding said engagement means in one of a first position and a second position, and for enabling said engagement means to disengage said magnetic head from said rotating magnetic recording medium upon oscillation to said second position and to release said horizontal surface of said head carriage upon oscillation to said first position so that said magnetic head is engaged with said rotating magnetic recording medium;

detecting means for detecting attainment of a state in which a system power supply of the magnetic recording/playback apparatus is of a voltage capable of supplying said driving power to said magnetic head advancing/retracting means and attainment of a state in which said system power supply is cut off; and

means responsive to detection performed by said detecting means for executing control of said latch-type solenoid so that said magnetic head is advanced to said engaged position or retracted to said disengaged position when the state is attained in which said system power supply is of a voltage capable of supplying said driving power to said magnetic head advancing/retracting means and is retracted to said disengaged position when the state is attained in which said system power supply is cut off.

2. The magnetic recording/playback apparatus of claim 1, wherein said detecting means detects attainment of the state in which said system power supply is of a voltage capable of supplying said driving power, when output voltage of a battery serving as said system power supply exceeds a predetermined value and a power supply switch is closed.

3. The magnetic recording/playback apparatus of claim 1, wherein said detecting means detects attainment of the state in which said system power supply is cut off when either said system power supply is turned off, an output voltage of a battery serving as said system power supply is less than a predetermined value, or said battery is removed from the apparatus.

4. The magnetic recording/playback apparatus of claim 1, wherein the magnetic recording medium is a magnetic disk which is inserted upon a disk plate, said magnetic head is advanced to engage with an underside of said magnetic disk.

5. The magnetic recording/playback apparatus of claim 4, said head carriage comprising:

a sliding portion including a recess running parallel along a radial direction in which said magnetic head is advanced along said magnetic disk during recording/playback;

a threaded lead screw housed within said recess and mounted rotatably to an apparatus base plate exteriorly of said recess; and

a sliding needle engaging said threaded lead screw and said head carriage for advancing said head carriage along a radial direction during recording/playback, said sliding pin actuable upon rotation of said threaded lead screw by a drive motor.

6. The magnetic recording/playback apparatus of claim 5, further comprising:

a first leaf spring, coupled to an underside of said head carriage, for upwardly biasing said head carriage away from said base plate; and

a first mounting base mounted upon said base plate including protruding second leaf springs extending therefrom cooperable with an upward portion of said head carriage for biasing said head carriage downward, wherein a vertical range of motion of said head carriage is limited by said first and second leaf springs.

7. The magnetic recording/playback apparatus of claim 6, further comprising:

a pair of second mounting bases mounted upon said base plate on an exterior side of said head carriage opposite a side of said first mounting base;

a pair of third leaf springs respectively mounted and protruding downward from said pair of second mounting bases; and

a rod, urged downward upon said horizontal surface of said head carriage by said pair of third leaf springs at respective first and second ends thereof, for stably supporting said head carriage on said exterior side in either of said first or second positions.

8. A magnetic recording/playback apparatus for a rotating magnetic recording medium, comprising:

bistable magnetic head advancing/retracting means, responsive to supply of a driving power, for advancing a magnetic head to an engaged position in contact with the rotating magnetic recording medium and for retracting said magnetic head to a disengaged position away from the rotating magnetic recording medium, and for stably holding said magnetic head at said engaged position or said disengaged position in the absence of supply of said driving power, said bistable magnetic head advancing/retracting means comprising

engagement means, positionable to be urged down upon a horizontal surface of a head carriage of said magnetic head, for retracting said magnetic head to the disengaged position from said rotating magnetic recording medium, and

a latch-type solenoid, responsive to supply of said driving power, for stably holding said engagement means in one of a first position an da second position, and for enabling said engagement means to disengage said magnetic head from said rotating magnetic recording medium upon oscillation to said second position and to release said horizontal surface of said head carriage upon oscillation to said first position so that said magnetic head is engaged with said rotating magnetic recording medium;

detecting means for detecting attainment of a state in which a system power supply of the magnetic recording/playback apparatus is of a voltage capable of supplying said driving power to said magnetic head advancing/retracting means and attainment of a state in which said system power supply is cut off; and

means responsive to detection performed by said detecting means for executing control of said latch-type solenoid so that said magnetic head is advanced to said engaged position or retracted to said disengaged position when the state is attained in which said system power supply is of a voltage capable of supplying said driving power to said magnetic head advancing/retracting means and is retracted to said disengaged position when the state is attained in which said system power supply is cut off,

said latch-type solenoid being driven by said driving power which is supplied as positive and negative pulses which respectively rotate an output shaft of said latch-type solenoid in opposite first and second directions to said first and second positions, said output shaft being stably held in said first and second positions after application of said positive and negative pulses.

9. The magnetic recording/playback apparatus of claim 8, wherein the magnetic recording medium is a magnetic disk which is inserted upon a disk plate, said magnetic head is advanced to said engaged position to

be in contact with only an underside of said magnetic disk.

10. The magnetic recording/playback apparatus of claim **9**, said head carriage comprising:

a sliding portion including a recess running parallel along a radial direction in which said magnetic head is advanced along said magnetic disk during recording/playback;

a threaded led screw housed within said recess and mounted rotatably to an apparatus base plate exteriorly of said recess; and

a sliding pin engaging said threaded lead screw and said head carriage for advancing said head carriage along a radial direction during recording/-playback, said sliding pin actuable upon rotation of said threaded lead screw by a drive motor.

11. The magnetic recording/playback apparatus of claim **10**, further comprising:

a first leaf spring, coupled to an underside of said head carriage, for upwardly biasing said head carriage away from said base plate; and

a first mounting base mounted upon said base plate including protruding second leaf springs extending therefrom cooperable with an upward portion of said head carriage for biasing said head carriage downward, wherein a vertical range of motion of said head carriage is limited by said first and second leaf springs.

12. The magnetic recording/playback apparatus of claim **11**, further comprising:

a pair of second mounting bases mounted upon said base plate on an exterior side of said head carriage opposite a side of said first mounting base;

a pair of third leaf springs respectively mounted and protruding downward from said pair of second mounting bases; and

a rod, urged downward upon said horizontal surface of said head carriage by said pair of third leaf springs at respective first and second ends thereof, for stably supporting said head carriage on said exterior side in either of said first or second positions.

13. A method of operating a recording/playback apparatus for rotating a magnetic disk comprising the steps of:

mounting the magnetic disk upon a disk plate within the apparatus;

transporting a magnetic head during recording/-playback along a radial direction across an underside of the mounted magnetic disk by rotating a threaded lead screw, housed within a recessed portion of a head carriage disposed parallel along the radial direction in which the magnetic head is transported, the lead screw mounted on a base plate of the head carriage exteriorly of the recess to be rotatably driven by a drive motor, a sliding needle, including opposing first and second ends which are embedded within the head carriage, engaging the threaded lead screw for transporting the head carriage in response to rotation of the threaded lead screw; and

advancing and retracting the magnetic head with respect to the magnetic disk to be respectively in an advanced position and a retracted position, the magnetic head being advanced toward the magnetic disk by releasing an engagement member of advancing/retracting means from a horizontal surface of the head carriage via an output shaft of a latch-type solenoid held in a first position responsive to of a negative pulse of a driving power supply and being retracted from said magnetic disk by engagement of the engagement member of the advancing/retracting means with the horizontal surface of the head carriage when the output shaft of the latch-type solenoid is held in a second position responsive to a positive pulse of the driving power.

14. The method of operating a recording/playback apparatus of claim **13**, said advancing and retracting step further comprising driving the latch-type solenoid to be in the first position or second position when an output voltage of a battery, serving to supply the pulses of the driving power, is capable of exceeding a first predetermined level and a power switch is activated and driving the latch-type solenoid to be in the second position when either the power switch is deactivated, the output voltage of the battery falls below a second predetermined level, or the battery is removed from the apparatus.

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RELATED PROCEEDING APPENDIX

RELATED APPEALS AND INTERFERENCES

None